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## THE INDUSTRIAL APPLICATIONS OF ATOMIC ENERGY\*

THE picture of the production of atomic energy for industrial purposes which we can envisage at the moment is not encouraging. The fast neutron reactors require rather concentrated fissile material as atomic fuel, and this is very difficult and expensive to produce. The slow neutron reactors utilize only a very small fraction of the rarer isotope of uranium and produce about the same quantity of plutonium. Much more than this must be achieved if atomic energy is to compete successfully with coal as a source of power. Fortunately, the way out is clear, though it has not yet been achieved in practice, and the solution brings with it the possibility of using thorium as well as uranium, as a nuclear fuel.

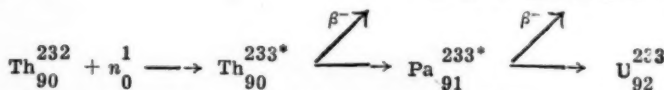
### "BREEDER" REACTORS

On the average a fission process releases several neutrons, say three. If it is assumed

that there are in the reactor no impurities or materials of construction other than uranium which absorb neutrons, the three fission neutrons can be utilized in the following way: At constant power output, one of these neutrons must produce a fresh fission by absorption into the nucleus of another fissile atom. A second neutron can be captured by uranium of mass 238 to produce an atom of plutonium, thus replacing the atom of fuel which has been used. The third neutron can be absorbed by a second U238 atom giving another plutonium atom. Thus a reactor operating in this way should produce more nuclear fuel than is burnt and is called a "breeding" reactor. The breeding process should make it possible to utilize the whole of the uranium, the plentiful U238 as well as the scarce U235. If the excess neutrons are absorbed in thorium instead of U238, a new fissile material which can replace U235 or plutonium is produced by a process very similar to that which produces plutonium. We

\* Abstracted from the 1950 Traeman Wood Lecture, by Prof. M. L. Oliphant, F.R.S.

can represent this process by the nuclear equation



The thorium nucleus absorbs a neutron producing a radioactive isotope of thorium of mass 233. This emits a negative electron or  $\beta$ -particle, transforming into a radioactive form of proto-actinium, which emits a further  $\beta$ -particle to give an isotope of uranium of mass 233.  $\text{U}^{233}$  is a fissile substance which can be used as a fuel in a nuclear reactor. Thus, in time, it should be possible to change over from uranium to the more plentiful thorium as fuel for the production of nuclear power.

The design of a successful breeding reactor depends upon the elimination from the reactor of materials which capture an appreciable fraction of the neutrons without contributing to the production of power or of fresh fissile material. There are reasons why this may prove to be more practicable with the fast neutron reactors than with those using slow neutrons, partly because the smaller mass of fissile material in the reactor can be prepared in a state of higher purity, partly because there is no moderator, but principally because the essential materials of mechanical construction and the cooling fluid which can be used in a fast neutron reactor are not so restricted in properties. The most important of the factors to which answers have yet to be found is the extent to which the materials in the reactor retain their physical properties of strength, etc., when the atoms of which they consist are continually stirred up and knocked out of place by collisions with fast neutrons.

#### EXPERIMENTAL PROGRAMME IN U.S.A.

The Atomic Energy Commission in the U.S.A. has announced the construction of two types of experimental breeding reactor and a materials-testing reactor. The first of these is designed to test the practical feasibility of breeding with fast neutrons and to investigate the application of liquid metals to the removal of fission-produced heat at high temperatures. The second will produce significant amounts of electric power from a reactor using neutrons in the intermediate range of energies, and at the same time determine whether breeding is possible under these conditions. The heat will be removed with liquid metal and power will be generated from this by conventional means. These breeder reactors, together with the

materials-testing reactor, are estimated to cost about 70 million dollars.

#### ECONOMIC COST OF NUCLEAR POWER

It is not easy to estimate as yet the economic cost of nuclear power. The energy derived from 1 lb. of uranium, completely utilized in a breeder reactor, is equivalent to that produced by burning 1,500 tons of coal. The cost of uranium is about 1,000 times the cost of coal. This leaves a factor of about 3,000 to cover the cost of converting the uranium to a form suitable for use in a reactor and the greater cost of nuclear reactor over a coal furnace. In the absence of precise data it is possible only to guess the ultimate answer. Nevertheless, I venture to think that the cost will ultimately be found to be competitive with, and probably much less than, the cost of power from other sources. The time required to reach this stage of development is not likely to be less than 10 to 15 years and clearly depends on the relative efforts devoted to the military and industrial objectives. Uranium is more widespread in occurrence than was thought to be the case and, with the development of methods for extracting it from low-grade ores, there should be sufficient available to provide a great contribution to the power resources of the world if it is not used for the manufacture of military weapons.

#### HYDROGEN AS A NUCLEAR FUEL

Finally, we must consider the possibility that industrial power may one day be produced from hydrogen. Long before the discovery of the fission process it was realized that under conditions of extremely high temperature and pressure, such as exist in the interior of sun and stars, hydrogen nuclei, or protons, might combine together to give nuclei of heavier elements and that because the component parts of heavier nuclei are very tightly bound together, sufficient energy would be released to maintain the temperature of the star. If it were possible to find a method by which heavier atoms could be synthesized from hydrogen at will and under controlled conditions, very large amounts of energy would be available. Thus, if four atoms of hydrogen condense to form an atom of helium, the energy set free is about five million times as great as that produced when an atom of carbon is burnt. In other words, 1 lb. of hydrogen transformed into helium would produce about 100 million kilowatt-hours

of heat energy, or about 130 million horsepower for an hour. Thus hydrogen as nuclear fuel would be about 10 times as good, weight for weight, as uranium. There are possible ways in which an explosive reaction of this type can be produced by utilizing the very high temperature and pressure developed in the explosion of atomic bomb, but so far there is no clue to a method for bringing about the reaction in a controllable way. However, it is interesting to speculate on the possibility that nuclear scientists may discover how to do this in the future.

There is enough hydrogen in the sea, if it were all converted into helium, to raise the temperature of the whole earth to at least one million degrees centigrade, i.e., over hundred times the temperature of the surface of the sun. Fortunately for us the possibility of bringing about such an explosion can be ruled out, if for no other reason than that if it were possible, it would have happened in the past history of the earth. However, if we accept

as the desirable power level for civilization that every individual should utilize, on the average, 1 kilowatt of power continuously, we can calculate that 3,000 million inhabitants of the earth could be supplied with power from the hydrogen of the sea for 1,000 million, million years, or for about a million times the age of the earth itself. Thus, if this remote possibility is realized, mankind would have no need to look elsewhere than to the sea for all the power they can conceivably use in the lifetime of the solar system.

In conclusion, it must be emphasised that industrial power from uranium is on the doorstep and will almost certainly be used successfully, while power from hydrogen is only a remote possibility in the light of existing knowledge. In any case, the probability is small that any nuclear power will be available for useful purposes unless the problems of war can be solved, and that is a question for all mankind and not for the scientist alone to solve.

#### ROCKEFELLER DONATION TO THE M.I.T.\*

THE Massachusetts Institute of Technology recently announced the receipt of a gift of \$1,000,000 from John D. Rockefeller Jr. to be used for "buttressing of the Institute's financial stability and independence as a private institution".

The gift was announced by Marshall B. Dalton, Chairman of the Institute's Development Program, at a meeting of more than 200 alumni members of the National Committee on Financing Development. The Committee was established in 1948 to "fund M.I.T.'s independence" through a \$20,000,000 development program. Mr. Dalton said that Mr. Rockefeller's gift increased to \$12,162,309 the total raised to date.

Mr. Rockefeller wrote to Dr. James R. Killian Jr., President of the Institute, that "because of the Institute's outstanding position of leadership in the field of science, the high order of service rendered by it, as well as the promise of future achievement which it gives, I am glad to have a part in the effort to broaden its educational program and strengthen its financial condition."

He expressed the hope that the Institute would continue to expand its "strategic service" to all interested in the advancement of science.

\* With acknowledgments to *World in Brief News Service*.

#### INTERNATIONAL CONFERENCE ON ATOMIC ENERGY

TWO hundred nuclear experts representing most of the Western nations and the Commonwealth countries are expected to attend the first big international conference on atomic energy to be held in Britain in September.

The conference is being organised by the British Atomic Energy Research Establishment. Most of the meetings will take place at Oxford

University and the conference will last one week.

Discussions will be divided into two parts. The first section will be mainly concerned with the use of high energy accelerators for experiments in nuclear physics. The second part will deal with work at lower energy levels and include discussions on the employment of atomic piles for research and experiments,

## THE PROBLEM OF THE CRETACEOUS-EOCENE BOUNDARY

L. RAMA RAO

(Central College, Bangalore)

OF all the 'Boundary Problems' in stratigraphy, the Cretaceous-Eocene boundary is the most interesting, and has been the subject of considerable study and discussion in many parts of the world. In all such studies, the usual tendency is to try to equate all correlations with those of the European stratigraphical scale and adopt the same terminology in describing the succession in the several places. While it is no doubt useful for us to have clear and definite ideas regarding the Cretaceous-Eocene transition in Europe in tackling similar problems in other countries, we must at the same time realise the inherent limitations in the process of long distance correlations and the danger in too readily importing 'European' ideas and seek to establish identity of chronological equivalence in widely separated parts of the earth.

It is obvious that the most favourable areas for the study of the Cretaceous-Eocene boundary are those places where we seem to have a continuous succession of marine fossiliferous sediments including the uppermost Cretaceous and the lowermost Eocene; if, in any area, this succession is not wholly marine but is interrupted by the occurrence of fresh water and fluvial beds in between, conclusions regarding the boundary naturally become doubtful and controversial.

In many parts of the world the dividing line between the Cretaceous and the Eocene is clearly indicated by a stratigraphical and/or palaeontological break in the succession revealing an unconformity or disconformity, and there is no difficulty here in defining where the one system ends and the other begins. There are a few places, however, as for instance in parts of western Europe, where no such break is recognisable; and it is these areas, though very small in extent, that are of particular interest in the study of the Cretaceous-Eocene boundary, and as such deserve special attention.

The position regarding this part of the succession in the European stratigraphical scale is indicated in Fig. 1. There is no doubt that the strata right up to and including the Maastrichtian belong to the Cretaceous; it is equally certain that the beds from the Thanetian upwards form part of the Eocene. Between these two subdivisions—the Maastrichtian and the Thanetian—we have a series of beds in different places whose exact position

in the scale is uncertain and controversial and these are the beds which cover the Cretaceous-Eocene transition period. Such transition beds are found in parts of western Europe including N. France, Belgium and Denmark; and even there, they occur in a number of

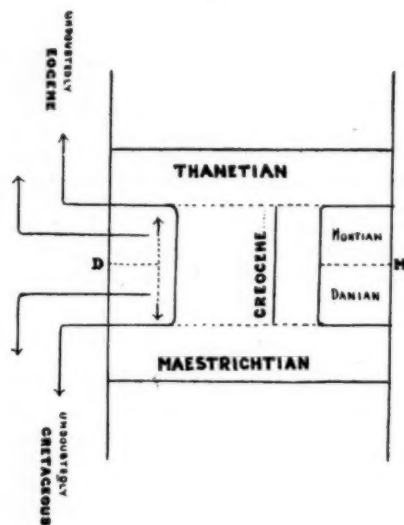


FIG. 1

The Cretaceous-Eocene Transition

small isolated patches with rapidly varying lithological and ecological facies. There is thus much difficulty in defining their classification and assigning the component beds as between the Cretaceous and Eocene. While a broad grouping of these beds into two divisions, the Danian and the Montian, is generally accepted, opinion regarding the relationships of each of these with the Cretaceous on the one hand and the Eocene on the other, have been varying. At one time it was thought that both the Montian and the Danian belonged to the Cretaceous; later, others believed that both of them formed part of the Eocene. Some others classified the Danian as the youngest Cretaceous unit including the Maastrichtian and the Montian as its lower and upper subdivisions.

In accordance with the generally accepted scheme, the Maastrichtian-Thanetian interval is shown in Fig. 1 as composed of the two divisions Danian and Montian, the dividing



line D M being drawn diagrammatically right in the middle and considered as demarcating the boundary between the Cretaceous and Eocene. But, actually, the position is not so simple. If we make a comparative study of different areas in and outside Europe, this significant line seems to shift upwards and downwards in the scale depending upon the local oscillations of sea level and varying with the particular basis, stratigraphical and/or palaeontological, on which we proceed to consider the question in each case. In some cases, the line shifts towards the Cretaceous side, thus reducing in degrees varying from place to place, the scope and importance of the Danian; while in others, the shift is towards the Eocene side, thus enlarging the Danian and correspondingly reducing the prominence of the Montian. The only satisfactory way to decide upon a boundary line in any area where we have such transition beds is to take a collective and comprehensive view of the stratigraphical and palaeontological evidences in that region with due regard to their previous and subsequent trends of development, and come to an agreement by a convention as to where to draw the boundary; for let us remember that where we have a really complete and continuous record of past changes, it is impossible to draw a hard and fast divisional line between the two systems which would hold good from all points of view, for the simple reason that such a line does not exist in nature.

The most important point to note is that any such boundary line which we may agree to draw between the Cretaceous and the Eocene upon the evidence in any particular area can hold good only for that region; it would be a great mistake to import those ideas to other parts of the world and seek to establish equivalence or non-equivalence of strata on the basis of one or two random criteria and thus try to solve the problem of the Cretaceous-Eocene boundary in these different places. On the other hand, the position in each region is to be judged on its own merits. While the general principles that must guide us are no doubt the same in all cases, the actual study of the transition and the drawing of a boundary line in any particular area must be decided on the evidences revealed in the localities concerned. It is particularly important for us to remember this point, for here, in India, we have

a most interesting field for the study of the Cretaceous-Eocene boundary\* awaiting proper investigation. The free and indefinite use of the terms 'Danian' and 'Montian', and the uncritical manner in which names of fossils like *Nautilus danicus* and *Cardita beaumonti* have been used as age fixers, have largely added to our confusion and trouble in studying this problem here.

It is obvious that the Cretaceous-Eocene boundary lies somewhere in the Maastrichtian-Thauetian interval; and all the beds falling in this part of the stratigraphical succession in any part of the world will constitute the 'passage' from the Cretaceous to the Eocene in that area. As such passage beds are usually of shallow water origin occurring in small, scattered, and localised patches, and showing variations in the facies of deposition, the mutual correlation of their transitional stages are not easy to decipher in widely separated areas. In the present state of our knowledge, it is best that all such 'passage beds' in any particular area are clubbed together as a composite group to which the term CREOCENE may be applied. The actual level in this assemblage where we agree to draw the boundary line between the Cretaceous and the Eocene in any given area has to be decided on the basis of the available stratigraphical and palaeontological criteria in that particular area, without for a moment imagining that such a line should be of universal applicability and be constant in its relative stratigraphical position throughout the world. From the point of view of world stratigraphy, the recognition of the 'Creocene' beds in any place is the really important point; for it means that here we have a succession representing the passage (wholly or partly) from the one system to the other and hence worthy of detailed investigation as contributing to complete our picture of the geological history during the Cretaceous-Eocene transition period; where exactly we agree to draw the boundary line between the two systems in the 'Creocene' succession of any given area is a local matter and is of no great consequence from the larger point of view of Earth History as a whole.

\* L. Rama Rao, Presidential Address to the Geology Section of the Indian Science Congress, 1940.

## THE POWER ALCOHOL INDUSTRY IN INDIA

Y. K. RAGHUNATHA RAO

(Bangalore)

THE production of power alcohol, for blending with petrol as a motor fuel has not made much headway in the last five years, despite the Governmental pronouncement and encouragement to sugar-factory owners. The output was less than a million gallons in 1945, and had not reached 5 million gallons three years later, whereas the target is over 20 million gallons a year. There are about twelve Absolute Alcohol Plants in service (9 in U.P.). Five more are expected to work and raise the output to 5 million gallons shortly. There is, however, little chance of many more units being put up by private owners. It is left to the Governments, Central and Provincial, to provide incentives to private enterprise or to set up plants themselves.

The lack of incentive to the private owners has been due to the advent of prohibition; large profits to distillers have vanished with the liquor trade. The U.P. Government, therefore, allows a portion of the product to be sold as rectified spirits for several industrial uses at a higher price than for absolute alcohol, bought by the State for blending with petrol. But to most sugar-factory owners, who have set up distilleries, the margin of profit is not adequate. They would desire it to be raised. The capitalist is not fully aware that though a higher price brings him more profits, an increased efficiency of production pays better and is a permanent advantage to all alike. At the moment, there is not much likelihood of the desirable change being made except at the instance of the Government. It lies within the province of the recently appointed Planning Commission to ensure the expansion of the industry by setting up model distilleries, training operative staff, devising means to solve urgent technical problems and to carry out research on related Fermentation Industries and thereby modernise the industry in the light of advances made in distillery practice.

A few technical problems, contributing to the high cost of production might be mentioned here; e.g., the disproportionate outlay on buildings, in some distilleries: indifferent design and construction of some plants: inadequate equipment for proper fermentation: absence of qualified technical staff and sometimes lack of appreciation by the management of the necessity for industrial research on the spot, or to take note of recent advances in the industry and to adapt them to local conditions,

For example, a problem often met with in some distilleries is the scaling of the stills, involving discontinuous operation. The molasses sometimes have high mineral content, 12 to 13 per cent., due to the nature of sugarcane or faulty liming in the factory. In such cases, clarification of molasses is indicated.<sup>1,7</sup>

In October 1944, the Council of Scientific and Industrial Research sponsored a research project for increasing the concentration of distillery washes from the 6-7 per cent. obtaining in Indian distilleries, to 12-14 per cent. The project has culminated in the development of a patented process<sup>2</sup> which seeks to eliminate the problem of scaling, effect a saving in fermentation capacity, increase the overall efficiency and reduce costs of production.

The process is not a laboratory scale curiosity; it is reported to have been successfully demonstrated on a factory scale in a couple of distilleries in Northern India.

TABLE I

Fermenter No.	1	2	3	4	5	6
Wash—Sp. Gr.						
Initial	1096	1096	1129	1129	1142	1150
Final	1032	1034	1050	1042	1047	1047
Attenuation	64	62	79	77	95	103
Alcohol % Vol.	9.35	9.0	10.85	10.3	12.74	13.3
Acids %	0.60	0.63	0.72	0.65	0.66	0.60
Unfermentable sugars %	1.10	1.13	2.14	2.90	1.76	1.80
Conversion of						
Initial Sugar	100	..	..	..	100	100
To Alcohol	83.58	..	..	..	84.87	82.5
To Acids	5.52	..	..	..	4.2	3.6
To other products	3.90	..	..	..	3.49	6.83
Unfermentable Sugars	6.84	..	..	..	7.43	7.00

It has now been possible to obtain 9 to 12 per cent. alcohol in distillery wash.<sup>3</sup> In this process, selected yeast is grown under controlled conditions<sup>4</sup> and developed in molasses wash and the final fermentation completed in 12,000 gallon steel fermenters. A partial adoption of the new process resulted in increasing output of a North Indian distillery<sup>5</sup> from 1,800 gallons daily to a maximum of 3,450 gallons of alcohol without appreciable alteration in plant. The steam consumption is reduced by 10 lbs. per gallon of alcohol produced, and other benefits having resulted, the cost of production goes down by a third of the original.

The appended Table I<sup>6</sup> shows data relating to the conditions of fermentation, attenuation obtained, and alcohol per cent. in the wash. Generally from 12 to 13 per cent. alcohol is obtainable with a conversion of 82 to 85 per cent. of the sugars in molasses to alcohol. These figures show that a high degree of efficiency is obtainable. By adoption of the new technique in all distilleries, I anticipate that the output could be doubled quickly to over 6 million gallons annually in India. It is, of course, necessary to use modern methods of fermentation control and obtain adequate technical advice to adapt the plant and equipment in existing distilleries, which are not all efficient ones.

The nature of molasses has much to do with fermentation; as North Indian molasses contain more minerals and sometimes bacterial contaminations, the process has to be adapted to suit the local conditions.

For expansion of output, the necessary measure is to instal many more small-sized plants, made locally but modern in design and workmanship. A 2,500 gallon unit made by the author is in service at Simbhaoli (U.P.). Smaller units could well be put up at suitable sugar factories, thereby avoiding expense on transport of molasses.

Production of Power Alcohol, a key industry whose importance has increased beyond expect-

tation ever since its use in the propulsion of rockets, could be stepped up either by the Government conceding a higher price to producers after inspection of the plants and insisting on the adoption of modern improvements to raise the efficiency, or by the State setting up a model full-fledged distillation units incorporating the latest improvements in technique and processing with the object of demonstration to the conservative factory-owners.

It is clear that there is a need immediately to set up requisite organisation for the establishment of the industry on a sound basis, for collection of data, study of its problems and of related industries.

With the implementation of such ideas in practice and with the co-operation of the present distilleries and sugar factories, the target of an annual production of 20 million gallons of power alcohol may be reached in less than five years, solving partially, the country's fuel needs.

1. Reich, G. T., *Amer. Inst. Chem. Eng.*, 1942, 38,
6. 2. Rao, S. R. A. N., and Sreenivasaya, M., 1918, *Ind. Pat. No. 38823*.
3. —, *J. Sc. & Ind. Res. Ind.*, 1945, 4, 295-7.
4. —, 1949, *Ind. Pat. No. 40112*.
5. Oudh Sugar Mills, Ltd., Hargaoon, U. P., India.
6. Rao, Y. K. R., *Indian Sugar*, 1949, 12, 6, p. 405.
7. Arroyo, R., U. S. Pat., 1942, 2295150.

### SCIENCE IN PAKISTAN

IN the course of his inaugural address at the All-Pakistan Science Conference held at Sind University, Karachi, the Governor-General H. E. Khawaja Nazimuddin very rightly pointed out, "If we are to build our State on progressive lines and bring about a radical change in the living conditions of our people, we shall have to make them scientific minded and harness the resources of science for the solution of the problem facing the country." He further said: "The Government of Pakistan envisaged an expenditure of 300 crores of rupees on various nation-building activities during the next ten years. In that great and worthy task of development, science and scientists must play their full part."

The Conference was held under the auspices of the Pakistan Association for the Advancement of Science which was founded soon after the establishment of Pakistan. Among the achievements made by the Association during its short existence of two years, mention may

be made of the publication of the Journals—*The Pakistan Journal of Science* and the *Pakistan Journal of Scientific Research*, which are the first scientific journals to be published in Pakistan.

The First Pakistan Science Conference organised by the Association last year, was a notable step towards the development of Science and Technology in the country. Apart from papers dealing with scientific research, which were read at the Conference, symposia were held on a number of subjects of national importance, among which were agriculture and forest wealth of Pakistan and possibilities of development; future of industrial development in Pakistan; the problem of waterlogging; scientific education. The main achievement of the Conference was to bring together scientists from different regions and from different institutions to discuss the vital problems and focus public attention on them.

(—By courtesy of *Science and Engineering*.)

## LETTERS TO THE EDITOR

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## RAMAN SPECTRUM OF CRYSTALLINE BARIUM CHLORATE

BARIUM chlorate crystallises in the monoclinic prismatic class with one molecule of water of crystallisation. A complete X-ray analysis of its crystal structure has not been made hitherto. Its Raman spectrum was first studied by Krishnamurthi<sup>1</sup> (1930) and later by Venkateswaran<sup>2</sup> (1938). Both of them reported the existence of only four Raman lines with frequency shifts 492, 612, 913 and 929 cm.<sup>-1</sup> Using the  $\lambda$  2536.5 excitation the author has recorded the Raman spectrum of barium chlorate [Ba (ClO<sub>3</sub>)<sub>2</sub> · H<sub>2</sub>O] in the form of a single crystal.

The recorded spectrum exhibits nineteen Raman lines with frequency shifts 54, 71, 87, 103, 123, 132, 156, 161, 196, 207, 487, 498, 612, 917, 933, 964, 986, 3513 and 3582 cm.<sup>-1</sup> They

could be classified under three heads: the first ten coming under the lattice spectrum, the next seven being due to the internal oscillations of the chlorate ion, and the remaining two being water bands.

As is well known, the chlorate ion in the free state possesses four fundamental frequencies, namely, 478 (2), 615 (1), 930 (1) and 975 (2) cm.<sup>-1</sup> The figures in brackets represent the degeneracies. It is seen that in the spectrum of crystalline barium chlorate, the degeneracies of lines 478 and 975 cm.<sup>-1</sup> have been removed and consequently one observes all the six oscillations due to the chlorate ion with frequency shifts 487, 498, 612, 933, 964 and 986 cm.<sup>-1</sup> It is interesting to point out that the sum of the frequency shifts of the first two lines is equal to that of the last line. The additional line appearing with frequency shift



917  $\text{cm}^{-1}$  can only be accounted for as due to a doubling of the principal chlorate ion frequency (930  $\text{cm}^{-1}$ ) which may probably be due to the multiplicity of ionic groups in the unit cell.

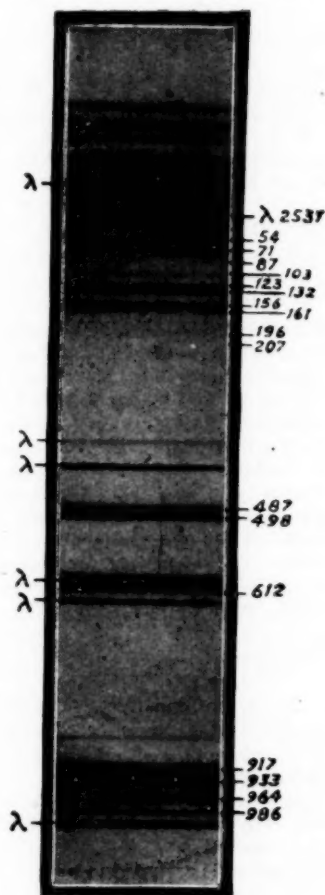


FIG. 1. The Raman spectrum of barium chlorate taken with a medium quartz spectrograph with an exposure of 16 hours. The region of water bands is not shown in this photograph.

The lattice spectrum of barium chlorate exhibits ten frequency shifts whereas that of potassium chlorate<sup>3</sup> which belongs to the same crystal class shows only five lines. Unlike many crystals which possess water of crystallisation, in the case of barium chlorate monohydrate, the O-H frequency appears as a very sharp line with a frequency shift of 3513  $\text{cm}^{-1}$ . This

is accompanied by a weak companion on the longer wave-length side, i.e., 3582  $\text{cm}^{-1}$ .

The author is grateful to Professor R. S. Krishnan for his kind encouragement.

Physics Department, C. SHANTA KUMARI,  
Indian Institute of Science,  
Bangalore.

June 19, 1950.

1. Krishnamurthi, *Ind. J. Phys.*, 1930, 5, 633.
2. Venkateswaran, *Proc. Ind. Acad., Sc.*, 1938, 8, 144.
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#### A NEW METHOD OF MEASURING THE ELASTIC CONSTANTS OF SOLIDS

In a note with the same title which appeared in the May issue of *Current Science*,<sup>1</sup> a new method of measuring the elastic constants of crystals of considerable size has been described. It consists in the use of a piezoquartz piece attached to the substance under investigation and the variation of ultrasonic energy transmitted through the substance with the frequency is studied over the entire resonance breadth of the piezoquartz. As the thickness of the specimen used is more than 1 cm., its fundamental frequency will be of the order of .1 to .2 Mc. Since the resonance breadth of the piezoquartz covers a fairly wide region, the ultrasonic energy transmitted through the experimental substance will exhibit a series of maxima when the frequency of the oscillator is continuously varied and it can easily be detected by using the familiar Debye-Sears and Lucas-Biquard arrangement. Each of these transmission maxima corresponds to the excitation of one of the harmonics of the longitudinal vibrations of the crystal block, and hence the difference in frequency between any two successive maxima will be equal to the longitudinal fundamental of the crystal plate. Knowing the longitudinal fundamental frequency, the thickness of the plate and the density of the substance, the effective elastic constant in the particular direction can be calculated. When this method was used to determine the elastic constants of some optical glasses, certain difficulties were experienced— which are enumerated below.

The optical glasses were in the form of rectangular blocks (3 cm.  $\times$  3 cm.  $\times$  2 cm.) and the thickness of these specimens did not vary by more than .003 cm. from 2 cm. The piezoquartz piece used was an X-cut crystal (20  $\times$  20  $\times$  1.5 mm.) purchased from Bernhard Halle, Berlin (the orientation of the crystal was also



checked by the X-ray diffraction method). Using the arrangement described above, it was found that over and above the true maxima, many spurious maxima were also observed, the intensities of the latter being practically of the same order as the true ones, thus making it impossible to distinguish the one from the other. It is well known<sup>2,3</sup> that due to the coupling with overtones of various l.f. modes the frequency spectrum of an X-cut plate in thickness vibration becomes extremely complicated. In other words, the intensity of the impinging ultrasonic energy, instead of increasing smoothly up to the resonance point and then falling down smoothly will have plenty of 'kinks'. Hence it is natural to expect that these extra kinks will also be reproduced in the energy transmitted by the experimental piece and hence recorded as well. These spurious maxima can in a way be eliminated by using a Straubel<sup>4</sup> X-cut plate, since a plate of this shape is somewhat freer from these multiple frequencies than rectangular or round plates. Using Straubel X-cut plate of thickness 1.00 mm. the results obtained are given in the following table. The corresponding values obtained by the Hiedemann's method<sup>5,6</sup> are also given for comparison. The procedure adopted in numbering the glasses is the same as in the earlier communication.<sup>6</sup> It is seen that the agreement is satisfactory.

Glass No.	$C_{11} \times 10^{-11}$ dynes/cm. <sup>2</sup>	
	by the new method	by Hiedemann's method
1	5.299	5.530
2	6.707	6.684
3	7.260	7.904
4	7.840	8.078
5	8.468	8.734
6	6.430	6.485
7	7.023	7.238
8	6.516	6.648
9	8.708	9.085
10	6.771	6.890
11	10.201	10.078
12	6.582	6.694
13	7.406	7.680
14	6.240	6.647
15	7.758	7.867
16	6.221	6.637
17	6.176	6.563
18	7.208	7.268

With an X-cut plate, the transverse vibrations do not come up prominently. But when a Y-cut plate is used instead, the same difficulties are again experienced and hence the constant  $C_{12}$  could not be measured.

The author wishes to express his grateful thanks to Professor R. S. Krishnan for his kind interest and constant encouragement.

Physics Department,  
Indian Institute of Science,  
Bangalore,  
June 27, 1950.

K. VEDAM.

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### A NOTE ON JOSHI EFFECT

IN the course of a discussion with Mr. Arnikaar of the Benares University, it emerged that an explanation of both the positive and negative 'Joshi Effect' and the other associated phenomena can be made on the basis of a standard picture of gas amplification given in textbooks,<sup>1,2</sup> by assuming that by some mechanism low energy visible light can produce additional ionization in the diode. Somewhat similar explanations have been advanced by Salzwedel<sup>3</sup> and Fuchs,<sup>4</sup> but the discussion can be summarised in terms of the following two arguments based on d-c operation.

(a) The major portion of gas amplification takes place near the anode.

This is evident from the well-known equation for electron current density  $J_e$  obtained from a gas-filled tube:

$$J_e = J_0 e^{\alpha d}$$

where  $J_0$  is the current density at the cathode face ( $d=0$ ) and  $\alpha$  is the number of ionizing collisions per centimetre of an electron's advance in the direction of the field.

(b) A strong ion sheath is created near the cathode which decreases potential gradient in the region of the anode.

If gas amplification is assumed to be 100, then  $J_e = 100 J_0$ . However, just near the cathode electron current density is  $J_0$ , and hence, according to the principle of conservation of total current, the positive ion current density near the cathode should be  $J_i = 99 J_0$ . But since  $J_e = \rho_e E g_e$  and  $J_i = \rho_i E g_i$ , where  $\rho_e$  and  $\rho_i$  are electron and ion space charge densities,  $E$  is the electric field, and  $g_e$  and  $g_i$  are electron and ion mobilities, and since  $g_e \gg g_i$ , then  $\rho_i E$  near the cathode is much larger than  $\rho_e E$  near the anode. Obviously, if by intense illumination ionization is further increased then a denser ion sheath near the cathode will alter the field distribution in the tube (see figure) in such a way that the poten-

tial gradient near the anode, and hence the gas amplification, will be decreased.

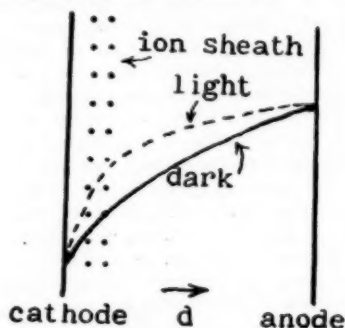


FIG. 1. Electric field distribution in light and dark

The analysis remains substantially the same for change of total current with light under a-c operation. The rate of rise or fall of current, the variation of ' $\Delta i$ ' of 'Joshi Effect' with intensity of light, and the appearance and suppression of high frequency pulses with light (for a-c) can be satisfactorily explained on this basis.

Physics Department,  
Aligarh University,  
April 19, 1950.

RAIS AHMED.  
P. S. GILL.

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# A NEW GENUS OF CALCAREOUS ALGA (DASYCLADACEAE) FROM THE RANIKOT BEDS (PALAEOCENE) OF THE PUNJAB SALT RANGE\*

CALCAREOUS algae both Dasycladaceae and Corallinaceae have been recorded from the Ranikot beds. Morellet<sup>1</sup> described several species of Dasycladaceae from the Ranikot beds of Tibet; Walton<sup>2</sup> described *Bræckella*<sup>3</sup> [= *Triptoporella ranikotensis* (Walton) from the Ranikot beds of Sind. Corallinaceae from the Lockhart limestone of the Samana Range have been described by Rao.<sup>4</sup> The present record is from the Ranikot beds of Nammal Gorge of the Salt Range and it represents a genus of Dasycladaceae hitherto not described.

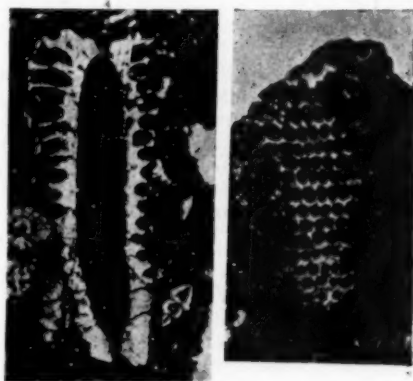
The material containing this new alga named

*Morelletpora nammalensis* gen. et. sp. nov. was collected by Professor S. R. N. Rao in 1946, from Khairabad Limestone beds (32° 40' : 71° 48') crowded with foraminiferal tests mainly of *Miscellanea miscella*. The diagnostic characters of this genus are based on the study of numerous thin sections and serial preparations.

The diagnostic characters of the genus are:

Thallus club-shaped, upper end rounded with a central depression occasionally open. Axial tube hollow, circular in section, bearing a number of branches of the first order only arranged in verticils forming the cortex. Branches arising as thin, upwardly inclined tubes, enlarging abruptly to form long oval to barrel-shaped sporangia, giving the thinner part a stalk-like nature.

**Description**—Thallus club-shaped (Fig. 1) upto 4.5 mm. long, round in section, upper end rounded 2 mm. wide with a depression, open in centre. Lower end also open, 0.7 mm. wide surface smooth with no definite pattern. Axial tube 0.2-0.8 mm. wide, longitudinally extending from base to tip. Branches arising in whorls, 0.1-0.2 mm. apart, each with 14-24 stalked sporangia. Stalks of adjacent whorls alternately arranged but the sporangia showing an arrangement neither strictly alternate nor strictly rowed (Fig. 2). Sporangial stalks



*Morelletpora nammalensis* Varma

FIG. 1. Nearly longitudinal section  $\times 17.5$ .

FIG. 2. Tangential section showing the cortical layer,  $\times 17.5$ .

0.02 mm. wide, 0.1-0.2 mm. separated from the next in its whorl. Each stalk enlarging in a sporangium oval or barrel-shaped, 0.1-0.2 mm. wide and 0.2-0.3 mm. long. Stalks in lower whorls longer, arising at angles between 50-70°; those in upper whorls, arising

at about  $45^\circ$  (range  $35-50^\circ$ ) ending in single sporangia on relatively short stalks.

**Comparisons**—The genus is readily distinguished from forms possessing secondary and tertiary branches by the fact that it is characterised by first order branches only. *Bræckella ranikotensis* (Walton) shows some similarity with it in external form of the thallus but differs, besides other minor details, in not possessing anything of the type of a stalk observed in the latter. Moreover, the former possesses secondary branches which are not present in the new genus.

Among forms possessing only the primary branches, the present genus shows some similarities with the genera *Gyroporella* and *Uragiella*. *Gyroporella vesiculifera*<sup>3</sup> Gumb. and *Uragiella suprajurassica*<sup>3</sup> Gumb. approach it in showing a tendency to form stalked sporangia. The former differs from the present one in having a cylindrical thallus, spherical sporangia and the stalks arising at right angles to the axis, along with many other minor details. The latter form differs in having a cylindrical thallus with club-shaped obliquely and upwardly directed branches which give a little hint of a very feeble stalk-like part.

Another comparable form is *Indopolia satyavanti* Pia<sup>5</sup> in which the primary branches resemble to some extent those of *Morelletpora*; but the form of the thallus and the presence of secondary branches, however, readily distinguish this from the *Ranikot* form. A fuller account will be published elsewhere.

I express my indebtedness to Prof. S. R. N. Rao for the guidance and the keen interest he evinced in this work; to Prof. T. M. Harris, F. R. S., for guidance in the study of serial sections and to Srimati Savitri Sahni for laboratory and library facilities at the Birbal Sahni Institute of Palaeobotany.

Dept. of Geology,  
Lucknow University,  
Lucknow,  
April 13, 1950.

C. P. VARMA.

\* The work has been carried out with the help of a grant awarded by the Scientific Research Committee of the U.P. Government.

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## STILPNOMELANE FROM BYRAPUR, HASSAN DISTRICT, MYSORE

DURING a recent visit to Byrapur Chromite Mines, an interesting type of quartz-chlorite schist was noticed containing a peculiar micaceous mineral developed all along the contact of the ultra-basics with the gneisses.

This mineral is brown in colour with a more or less metallic lustre exhibiting the typical micaceous structure. But, unlike mica, the folia are inelastic and brittle. Thus it would seem to resemble vermiculite; but unlike vermiculite it does not expand on sudden application of heat, although a change in colour is noticeable. This mineral is now identified as stilpnomelane which has not been reported so far in India, except for just a mention recently by A. K. Saha<sup>1</sup> of its possible occurrence in the dolerite sills, south of Katigutu, Chaibasa. Its optical characters are set forth in this paper.

Microsections of the rock show the mineral stilpnomelane occurring in association with quartz, talc, anthophyllite and chlorite. The mineral occurs in radiating or sheaf-like aggregates and is intimately interlaminated with chlorite from which it seems to be in the process of developing. It occurs as well-defined micaceous flakes exhibiting good cleavage but the cleavage traces are not so regular or continuous as in micas. It shows positive elongation and a distinct pleochroism with the following scheme:—

X = Yellowish.

X < Y = Z.

Y = Z = Reddish brown.

The extinction is parallel to the cleavage as in micas. Typically the mineral is uniaxial and negative but occasionally a slight breaking up of the cross is seen on rotation of the stage thereby giving a distinctly biaxial figure with a small optic axial angle. Refractive indices as determined by the immersion method are as follows:—

$$\alpha = 1.605$$

$$\gamma - \alpha = 0.090.$$

$$\beta = \gamma = 1.695.$$

The birefringence of the mineral as determined by Berek's compensator is 0.089. Thus, it is seen that this mineral has got a strong resemblance to biotite in optical characters.

Though this mineral resembles a chlorite or a vermiculite in physical properties or a biotite in optical characters, a closer examination of its optical characters reveals that it cannot be any one of these minerals. On the other hand, there is a very close resemblance between it and the minerals of the stilpnomelane group.

PUR,  
E  
chromite  
chlorite  
mica-  
contact

as indicated by the very high birefringence, 0.090, which is the most important and characteristic optical feature of the stilpnomelane group of minerals,<sup>2</sup> as shown in the following table:—

Birefringence	
Chlorite .....	0.000 to 0.015
Vermiculite ....	0.020 to 0.030
Biotite .....	0.030 to 0.060
Stilpnomelane ..	0.043 to 0.110
Micaceous mineral from Byrapur (stilpnomelane) ....	0.090

Besides the optical characters, this mineral also resembles closely the minerals of the stilpnomelane group in its mode of occurrence. Here it occurs in intimate association with talc, anthophyllite and chlorite and thus resembles the stilpnomelane of the iron formations of Cuyuna and Mesabi ranges of Minnesota,<sup>3</sup> where a similar mineral assemblage has been noticed. It is also observed that this mineral occurs intimately interlaminated with chlorite from which it is seen to be developing, this transition being more evident round about magnetite grains. Such a feature has also been noticed in the minerals of the stilpnomelane group from Western Otago, New Zealand.<sup>4</sup> The associated characteristic mineral assemblage indicates that this is a mineral of the low grade metamorphism in which stress has been the dominant factor.

In the early days, the presence of the minerals of stilpnomelane group had been overlooked, on account of their general resemblance to biotite. It is only recently that (Hallimond,<sup>5</sup> 1924; Hutton,<sup>6</sup> 1938; Gruner,<sup>7</sup> 1937 and 1944) a detailed investigation of the chemical composition, optical characters and X-ray analysis of stilpnomelane and related minerals has been made as a result of which a separate and distinct group namely "Stilpnomelane group" has come to be recognised in Mineralogy.

Rough chemical data, however, can be read off from the variation diagram, given by Hutton<sup>8</sup> for the stilpnomelane group of minerals. Computed from this variation diagram, the mineral from Byrapur is seen to contain 47% (Fe, Mg, Mn)<sub>2</sub>O molecule and 53% (Fe Al)<sub>2</sub>O<sub>3</sub> molecule. Therefore this mineral, being a ferric-rich variety, is identified as stilpnomelane.

It is evident from Hutton's<sup>9</sup> study of the analyses of the stilpnomelane from the Western Otago schists of New Zealand that these minerals, unlike biotite, are characterised by a low percentage of K<sub>2</sub>O and a high Fe<sub>2</sub>O<sub>3</sub>. The actual chemical analysis of the mineral

from Byrapur is expected to confirm its identification as stilpnomelane now made on the basis of its optical and other characters. Further work is in progress.

Department of Geology, M. G. C. Naidu,  
Central College,  
Bangalore,  
June 5, 1950.

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#### HETEROGENEOUS OLEFINIC NATURE OF ALIPHATIC SIDE CHAIN OF THE MONOPHENOLIC CONSTITUENT OF COMMERCIAL RAW CASHEW NUT SHELL LIQUID

THE monophenol obtained by vacuum distillation, after decarboxylation, of commercial raw cashew nut shell liquid, extracted by heat treatment of the whole nut shells, was shown by Wasserman and Dawson<sup>1</sup> to be 3-pentadecadienyl phenol (cardanol); chemically identical with the monophenol obtained by earlier investigators<sup>2</sup> by decarboxylation of anacardic acid got by solvent extraction of the shells of the nut.

Later, however, Slettinger and Dawson<sup>3</sup> observed that repeated distillation of methyl ether of the monophenol resulted in the reduction of the number of double bonds in the side chain from 2 to 1.53, and concluded to the phenol being in fact a mixture of mono-, di- and possibly higher olefinic components, the loss of unsaturation being attributed to selective polymerisation of the higher olefinic components.<sup>4</sup>

Experimental evidence of a different type is here presented as to the heterogeneity of the olefinic character of the aliphatic side chain of the phenol, obtained from iodine numbers of various samples from the commercial liquid distilled at different pressures. The results are presented in Table I which contains in each column the pressure in mm. Hg at which



TABLE I

Dist. Press. in mm.	..	2	5	20	30	60	100	200	760
Iodine Number	..	331.0	325.6	321.2	319.8	307.7	309.1	284.0	229.2
Double Bonds	..	1.95	1.85	1.79	1.76	1.63	1.55	1.36	0.71

distillation, after completion of decarboxylation, of the commercial liquid was carried out, the iodine number of the sample obtained and its calculated average number of double bonds per molecule.

In calculating the iodine number from results obtained by using Woburn solution,<sup>5</sup> it was assumed, on the basis of evidence adduced by Wasserman and Dawson,<sup>1</sup> that the side chain did not suffer any rupture during distillation, so that the same molecular weight of 300 could be assigned even to the less unsaturated samples without introducing substantial errors. Furthermore, in deducing the number of double bonds, correction was made for the substitution of four hydrogen atoms in the nucleus by halogen atoms, justification for this being the very reactive nature of these positions in the phenolic nucleus with unsaturated aliphatic side chain in meta-position. It must, however, be added that these assumptions might not necessarily hold good in the case of atmosphere distilled sample which shows an abnormally low unsaturation.

The decrease in the average number of double bonds with increase in distillation pressure and consequent increase in temperature, seems to be due to progressive polymerisation, aided by increased temperature of di- and higher olefinic components, as substantiated to some extent by a corresponding decrease in percentage yield of the phenol. For instance, a rough estimation of yield of phenol compared to the raw liquid taken, is 62% at 2 mm., 57.5% at 100 mm., 55% at 200 mm., and 50% at atmospheric pressure.

Further chemical investigation of the samples distilled at different pressures is in progress.

Dept. of Chemistry,  
Loyola College,  
Madras,  
June 1, 1950.

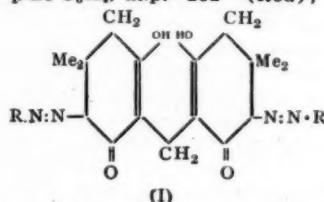
V. J. PAUL.  
N. T. MATHEW.  
G. R. MOHAN.  
L. M. YEDDANAPALLI.

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### AZOFORMALDIMETHONE DYES

Like methone,<sup>1</sup> formaldimethone (methylenebismethone) possesses phenolic properties and couples readily with diazonium compounds to give dyestuffs (for which formula I is provisionally assigned) ranging in colour from vermillion red to violet. The following dyestuffs have been prepared in this manner starting from the appropriate amines:

- (1) R=C<sub>6</sub>H<sub>5</sub>, m.p. 138-9°, (vermillion red);  
(2) R=p-Br C<sub>6</sub>H<sub>4</sub>, m.p. 202° (Red);



- (3) R=O-tolyl, m.p. 125° (Red); (4) R=p-xylyl, m.p. 132-3° (Red); (5) R=1:2:3-xylyl, m.p. 125-7° (Red); (6) R=α-naphthyl, m.p. 135° (Dark Red or Brownish Red); and (7) R=β-naphthyl, m.p. 198° (Red-Violet). These compounds are crystallised from alcohol. Experiments on reduction of some of these dyes and dyeing properties on wool and silk are in progress.

Our thanks are due to Prof. P. C. Guha for his kind interest in the studies.

Org. Chem. Laboratories, M. V. KOWJALGI.  
Ind. Inst. of Science, B. H. IYER,  
Bangalore,  
April 11, 1950.

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### THE POSSIBLE ASSOCIATION OF COLIFORM BACTERIA WITH CLOSTRIDIUM LACTO-ACETOPHILUM IN NATURE

A PREVIOUS communication gave<sup>1</sup> a detailed account of *Cl. lacto-acetophilum*, a strict anaerobe fermenting lactate. This organism in pure cultures was shown to depend upon added acetate for its growth and for the fermentation of lactate, whereas in crude enrichment cultures it was reported to have grown vigorously and fermented lactate despite the fact that the



enrichment culture medium did not contain any added acetate beyond about 3-5 mg./100 ml. introduced therein in the form of yeast-autolysate used as an ingredient. From several experiments it was concluded then, that in the enrichment cultures some other factor, possibly a second organism, was operating with the *Clostridium* in such a way as to make the addition of acetate unnecessary.

Further evidence in support of this view was derived from experiments carried out with radio-active  $C^{14}$ .<sup>2</sup> In pure cultures the *Clostridium* fermented lactate, but did not utilize  $CO_2$ \* provided in the fermenting medium in the form of labelled bicarbonate; consequently the fatty acids formed were inactive. In the enrichment cultures, on the other hand, not only the resulting acids were found to be specifically active but that the labelled  $CO_2$ \* was clearly shown to have been utilized in the process. This clearly indicated that *Cl. lacto-acetophilum* by itself cannot utilize  $CO_2$  and that in the enrichment cultures some other species must be involved in the fermentation of lactate.

Attempts to isolate the associating organism resulted in the isolation of nine cultures of Gram-negative, non-sporulating, non-capsulated bacteria from four cultures set up with three different samples of soil. These bacteria on complete identification could be placed among the Coliform bacilli; eight cultures agreed well with *E. freundii* and the remaining culture was characteristically that of *A. aerogenes*.<sup>3</sup> When, however, the *Clostridium* (Strain No. 3 on which all previous work has been carried out) was grown in association with these nine cultures separately by the glass-stoppered bottle method, it was observed that the disappearance of lactate from the mixed cultures was in greater quantities than that observed from the corresponding control samples where either the *Clostridium* alone or the nine bacteria were acting separately. Whereas the *Clostridium* could decompose lactate in quantities varying from 41 to 59 mg./100 ml. of the culture in 5 days, the Coliform bacteria from 93 to 158 mg. during the same period, in mixed cultures quantities ranging anywhere between 392 and 509 mg./100 ml. were decomposed during the very same period. Moreover, the growth of the *Clostridium* was observed to be much better in the presence of these Coliform bacteria. It was, however, repeatedly observed that even then the mixed culture was not comparable in vigour with the natural enrichment culture.

A further attempt was made to see if the two organisms can grow in association under somewhat altered conditions. The mixed and the pure culture sets were made in the enrichment medium in a series of Smith's fermentation tubes provided with aerobic plugs and incubated at 37° C. for 5 days as before. The *Clostridium* by itself failed to grow under these conditions; the Coliform bacteria grew well and produced from lactate pure acetic acid as the metabolic product. In mixed cultures, however, the *Clostridium* did grow, though less vigorously than in the bottle cultures, and even produced butyric acid, its characteristic product of metabolism. The ratio of butyric to acetic acid was, however, only 0.25 to 0.33 as compared to the enrichment cultures or the pure cultures wherein the ratio was as high as 1.1 to 2.6. This observation justifies one in pointing out the Coliform bacteria as the organisms operating in the enrichment cultures with the *Clostridium*, but they certainly do not appear to be the *only* species concerned. (The ability of the Coliform bacteria to utilize  $CO_2$  is another point in support of this view.) Probably there is one more partner concerned in the process but not yet isolated, or it may even be that the *only* associant has slipped through these isolations and may be trapped on a future occasion.

Further work is in progress and these results are in the meantime offered for comments and suggestions.

Microbiology Department,  
St. Xavier's College,  
Bombay,  
May 17, 1950.

J. V. BHAT.

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#### THE METABOLISM OF RATS RECEIVING CHOLINE AT DIFFERENT LEVELS

THE lipotropic activity of choline has now been attributed to its ability to increase the rate of turnover of phospholipids in the liver.<sup>1,2,3</sup> Choline has also been shown to be the donor of methyl groups for the biosynthesis of methionine.<sup>4,5</sup> The ability of choline to accelerate the rate of turnover of phospholipids prompted investigation as to whether it exercises any influence on the metabolism of nitrogen, phosphorus and sulphur in rats fed on a diet deficient in lipotropic factors, and

designed to cause fatty infiltration of liver in rats.

Twelve rats of the Haffkine inbred strain were divided into three groups of which the second and the third were fed choline chloride at 100 and 250 milligrams per cent. respectively, for a period of 18 days during which collections were made for analysis for each three-day period separately. Table I summarizes the

TABLE I

Influence of choline on the metabolism of rats

	Control	100 mg. choline chloride per cent.	250 mg. choline chloride per cent.
Increase in weight of rats (grams)	2	7	7
Total food intake (grams)	85.75	88.22	92.23
Nitrogen metabolism :*(mg.)			
Urinary nitrogen	81.1	46.4	97.7
Faecal "	117.86	118.24	109.04
Retention	762.39	823.36	826.21
Phosphorus metabolism :*(mg.)			
Urinary phosphorus	46.0	27.0	54.0
Faecal "	52.96	54.53	62.60
Retention	432.69	465.48	455.33
Sulphur metabolism :*(mg.)			
Urinary sulphur	7.83	6.31	7.97
Faecal "	20.01	20.96	21.74
Retention	-2.11	-0.80	-2.04
Analysis of liver :*(grams)			
Fresh weight	4.44	4.87	4.80
Weight of liver as per cent. of body weight	6.34	6.37	6.27
Fat content of liver	0.7080	0.2875	0.3620
Fat per cent. of liver	15.95	5.90	7.54

\* The figures for metabolism are for the total period of the experiment.

results of the experiment and indicates that while the lower level of choline supplement brings about a distinct sparing action on all the three constituents investigated, the higher supplement just reverses it, raising the total for the period of experiment to a little higher than that in the control group. The analysis of the livers of the rats in the experiment showed that the fat percentage at both the levels of choline supplement was almost the same, though there ought to have been a further decrease in the fat content in the liver if the lipotropic activity of choline is dependent on its availability for phospholipid formation. This negative result leads to the suggestion that the lipotropic activity of choline may be just an intermediary process for transporting choline to the site of metabolism without acetylation and that choline may have

some other more important function in metabolism different from its role as a donor of methyl groups for the formation of methionine or creatinine.

Further communications in elucidation of this point will follow.

My thanks are due to Major-General Sir S. S. Sokhey and Dr. K. Ganapathi for facilities to continue this investigation.

Haffkine Institute,  
Bombay,  
March 16, 1950.

V. SADASIVAN.

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#### ON THE CARENES IN INDIAN TURPENTINE OIL FROM *PINUS LONGIFOLIA* ROXB.

THE possible existence of an additional, unidentified terpene apart from  $\Delta^3$ -carene described by Simonsen<sup>1</sup> in the carene fraction of the oil from *Pinus longifolia* is evident from the work of Dupont<sup>2</sup> and Joffre.<sup>3</sup> That this is probably  $\beta$ -carene is suggested by the production of formaldehyde on ozonisation of the carene fraction, and the isolation of the semicarbazone of the ketone,  $C_{10}H_{14}O$ , m.p. 210–11°.<sup>3</sup> Equally in harmony with the above facts are the results of study of the Raman effect in  $\Delta^3$ -carene of the oil.<sup>4</sup> Hence, the report of Guha and Roy<sup>5</sup> on the presence of  $\Delta^4$ -carene in a fraction b.p. 164–68°/680 mm. of the oil distilled by them appears rather surprising. As no concrete evidence is given for this, and as  $\Delta^4$ -carene does not yield well-authenticated crystalline derivatives, it is suggested that due consideration be given to their findings before justifying  $\Delta^4$ -carene as an additional constituent of the oil.

Department of Chemistry, JAMES VERGHESE  
Sree Narayana College,  
Quilon,  
May 12, 1950.

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**A MOSAIC DISEASE OF CROTALARIA MUCRONATA DESV. (C. STRIATA DC.)**  
A MOSAIC disease of *Crotalaria mucronata* Desv. (*C. striata* DC.) has been commonly observed at the Indian Agricultural Research Institute.

It starts on the youngest leaves in the form of pale areas, occasionally with a slight downward curling of the tips of affected leaves. This curling disappears later and typical mosaic mottling appears on the lamina and a few pale interveinal areas are observed on the older leaves. Unlike in the mosaic disease of *Crotalaria juncea*,<sup>1</sup> the leaf size is rarely reduced and abnormal growth of the lamina associated with blistering of the leaf is not met with (Fig. 1).

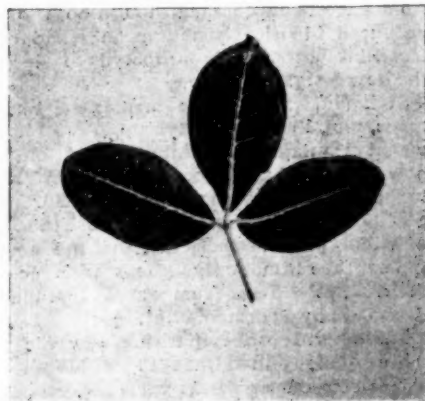


FIG. 1. mosaic-affected leaf of *Crotalaria mucronata*.

The disease can be readily transmitted by sap-inoculation to *Crotalaria mucronata*, *C. juncea*, *Vigna sinensis*, *Phaseolus mungo* and *P. aureus* and the symptoms appear within seven to twelve days after inoculation. The virus could not be transmitted to *Cajanus cajan*, *Vicia faba*, *Nicotiana tabacum*, tobacco var. White Burley and *Lycopersicon esculentum*.

The virus has a thermal death-point of 80°-85°C., a longevity *in vitro* of 134-142 days when stored at 12°-15°C. and in crude sap can tolerate a dilution of 1 : 20,000 to 1 : 30,000.

Cook<sup>2</sup> observed a mosaic disease of *Crotalaria mucronata* which is responsible for the dwarfing of the plant and reduces seed production, but is not seed-borne. The effect of mosaic on cell structure and chloroplasts in this plant was also studied by Cook.<sup>3</sup> Phyllody was observed by Cooper<sup>4</sup> on the same host in Bombay. Recently Capoor<sup>5</sup> described 'Southern sannhemp mosaic' virus from Poona which is

transmissible to many species of *Crotalaria* including *C. mucronata*. This virus is quite distinct from the mosaic reported herein.

Div. of Mycology & S. P. RAYCHAUDHURI.  
Plant Pathology, P. S. PATHANIAN.  
Indian Agri. Res. Institute,  
New Delhi,  
February 21, 1950.

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### ON THE BREEDING HABITS OF THE RIBBON FISH

#### TRICHIURUS HAUMELA (FORSK.)\*

ALTHOUGH ribbon fishes provide an important fishery along the east and west coasts of India, their shoaling, breeding and spawning habits have not been investigated in detail. Venkatraman<sup>6</sup> gave a short account of the feeding habits of ribbon fishes of the Malabar coast, and Chidambaram and Venkatraman<sup>1</sup> dealt with the natural history of ribbon fishes.

A detailed investigation on the minimum size at maturity and the spawning habits of the common Madras species, *T. haumela*, was undertaken during the period 1947-49. Observations based on about a thousand specimens of this species show that it is sexually mature when it attains a length of 47-48 cm. The age at maturity could not be determined from the inconspicuous growth zones on otoliths, nor are scales present in ribbon fish for study of growth rings. The occurrence of gravid ribbon fish in April and May and their reappearance in spent condition in July lead to the conclusion that the former have spawned in the interval. This inference is confirmed by the study of the diameters of 1300 ova in sections of ovaries in the last and penultimate stage of maturity, and is supported by work on similar lines by Hickling and Rutenbergh.<sup>4</sup> The fact that maturing eggs are sharply differentiated from immature eggs makes it probable that spawning is restricted to a definite and short period. The non-occurrence of the eggs in the plankton and of the spawning adults of Stage IV (of the International Council for the Exploration of the Sea) in the coastal waters seem to show that the species breeds probably in the off-shore waters. Devanesan and Chidambaram<sup>5</sup> and Jacob<sup>6</sup> have, however, recorded, in plankton collected in October 1939, eggs of what they believed to be ribbon fishes. The eggs of ribbon fishes are so remarkably

alike that it is very difficult to refer them to their respective species until their development is followed to the stage at which specific differentiation is possible (*vide* Delsman, 1926). As no developmental details are provided by them, it is open to doubt if the eggs recorded by them belong to *T. haumela* at all. Jacob<sup>5</sup> suggests the possible occurrence of two spawning seasons or a single prolonged one. The present observations do not support his suggestion.

Volumetric analyses of the gut contents for a continuous period of one year indicate that feeding activity of *T. haumela* increases soon after spawning. Besides prawns and white bait which constitute their favourite food<sup>6</sup> the following have also been found in the gut:—*Caranx* spp., *Dussumieria* spp., *Sardinella* sp., *Kowala thoracata*, *Mugil* spp., *Equula* sp., *Gazza* sp., and *Trichiurus* spp. Among the crustaceans the most common were *Penaeus* spp., *Metapenaeus dobsonii* and *Acetes* sp. Young ones of *Sepia* constitute the rarer items of food. During intensive feeding, *T. haumela* seems to develop cannibalistic tendencies judging from the large number of mutilated individuals of the same species which clog the gut.

A detailed account of these investigations will be published elsewhere.

My thanks are due to Dr. H. Srinivasa Rao for his guidance and encouragement.

Central Marine Fisheries M. S. PRABHU.  
Research Station,  
Mandapam Camp,  
May 19, 1950.

\* Published with the kind permission of the Chief Research Officer, Central Marine Fisheries Research Station, Mandapam Camp, South India.

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#### A NEW BIOTYPE OF RACE 15 OF PUCCINIA GRAMINIS TRITICI

UREDIA of susceptible type were noticed on Charter in the field plots at Mahabaleshwar during the severe epidemic of stem rust of wheat (*Puccinia graminis tritici*) in 1946-47. The fact that Charter was resistant to the physiologic races of this rust known to

occur in India till then,<sup>2,4</sup> made the writer suspect the presence of a new race. Uredospore material, multiplied on the seedlings of N.P. 4, was utilised for inoculating the seedlings of Charter, raised in a rust-free room of the glass-house. The resulting reaction was of a susceptible type, whereas the same variety proved resistant when inoculated with a mixture of the known races. Single-spore culture of the new isolate, established on N.P. 4, when tested on the twelve standard differential wheat varieties, showed that the reactions produced by the new isolate closely agreed with those produced by race 15, originally supplied by Mehta. Since Charter is resistant to race 15 of Mehta but susceptible to the new isolate, it is surmised that the new isolate is different from race 15 of Mehta, although both of them produced identical reactions on standard differential hosts. It is proposed to designate the new isolate as 15 C.

Stakman, *et al.*,<sup>3</sup> have mentioned two biotypes, viz., 15 A and 15 B within race 15. Rival wheat is resistant to 15 A but susceptible to the new biotype 15 C. According to Hart,<sup>1</sup> *Triticum timopheevi* is immune from race 15 A but susceptible to 15 B. It is, however, resistant to the new biotype. It seems clear that the new biotype of race 15 not only differs from race 15 of Mehta but differs from races 15 A and 15 B described by Stakman, *et al.*

Table I will prove that the new biotype is more virulent than race 15 of Mehta, since some of the exotic wheat varieties, resistant to all the previously known races of *Puccinia graminis tritici* in India, are susceptible to it.

TABLE I

Comparative reactions of some exotic wheat varieties to the known physiologic races of *Puccinia graminis tritici* in India and to the new biotype 15 C.

Wheat varieties	Reaction to races 15, 21, 24, 34, 40, 42, 42B, 75, and the unnumbered races A and B		Reaction to the new biotype 15 C
	(Range of infection types)		
60B-12B-16L ..	0 to 2*		2 & 3
Bobin x (Bobin x Gaza) ..	0, 2		3
C, 14112 ..	0, 2		4
Charter ..	0, 2		4
Gabo ..	0, 2		3
Gaza Q ..	0, 1		4

\* Explanation of symbols:—0-immune, 1-highly resistant, 2-moderately resistant, 3-moderately susceptible and 4-highly susceptible.

Q—The only *durum* wheat resistant to all known races of stem rust in India except the new biotype 15 C.



Fortunately, the new biotype was not observed in nature for three years after its first appearance in 1946-47. Even then, it was present in a small proportion. The wheat varieties in Table I, which are resistant to the races occurring in India at present, have been used for breeding rust-resistant varieties for the states of Bombay and Madhya Pradesh. Since they are susceptible to race 15 C, the present programme of hybridization will have to be reoriented if it reappears in significant proportion. The object of this note is to draw the attention of the Wheat Breeders in India to this potentially dangerous race. Varieties like Kenya E. 144, C. 9906, 291. J.I.I., etc., are however resistant to the old races as well as the new one.

The writer is grateful to Dr. B. N. Uppal and Dr. M. K. Patel under whose guidance the work was done.

Wheat Rust Station,  
Mahableswar,  
February 4, 1950.

V. P. GOKHALE.

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### ANTHESIS IN *CAJANUS INDICUS* SPRENG.

THE phenomenon of anthesis is a very interesting feature in plants and it has a great bearing in plant breeding work. Chandrasekharan and Parthasarathy<sup>1</sup> have reviewed the mechanism of anthesis in some of the Indian crop plants. The present note deals with anthesis in *Cajanus indicus*.

Observations were made during the months of December 1949 and January 1950 for determining the mode of anthesis in a particular variety of *Cajanus indicus* T no. 216-061, cultivated in the Hebbal Agricultural Farm, Bangalore. Anthesis in this plant takes place in the morning between 9 a.m. and 1 p.m., the maximum rate of anthesis being between 10 and 12 noon. During the time of anthesis the average temperature ranges from 27° C. to 32° C, the rate of anthesis being maximum between 29-31° C.

The actual opening of the anthers in a large number of flowers showed certain interesting features. The dehiscence of the anther takes

place longitudinally and usually the time taken for the complete anthesis of a stamen is about twenty minutes. In a stamen the two anther sacs open one after another. To start with an anther sac begins to open longitudinally from the distal end. During this process of longitudinal opening, the other anther sac also opens in a similar manner from the distal to the proximal end. The time taken for the complete anthesis in a stamen is twenty minutes and the various stages in the opening of the two anther sacs are shown in Fig. 1.

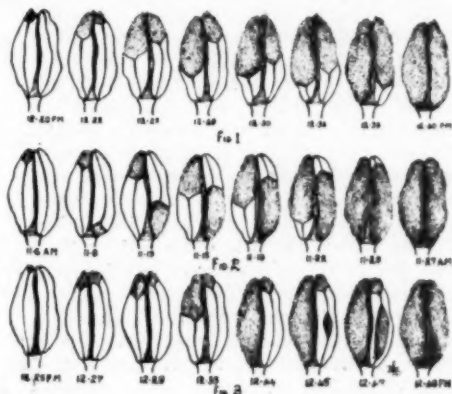


Fig. 2 shows a variation where while one anther sac opens from the distal end, the other opens from the proximal end. Sometimes it was noticed that if one anther sac opened longitudinally, dehiscence in the other anther sac had not at all progressed to an appreciable extent. In such cases (Fig. 3) a slit appeared in the middle of this anther sac and this gradually extended both distally and proximally, thus bringing about the dehiscence of this anther sac also.

Sincere thanks are due to Dr. L. S. Doraiswamy of the Department of Agriculture, for valuable suggestions, to Sri. A. K. Ramu for help in field observations and the National Institute of Sciences of India for the award of a Research Fellowship.

Department of Botany, K. SUBRAMANYAM.  
Central College,  
Bangalore 1,  
July 3, 1950.

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## TWO GRASS SMUTS

*Dactylis glomerata* is an introduced grass common in Ootacamund. A leaf smut was prevalent on this during the winter (November 1949 to February 1950). Numerous black sori were observed on the older leaves. The sori were amphigenous, minute, almost rectangular and limited by the veins, 0.25 to 1.50 mm. long and 0.1 to 0.3 mm. broad. The sorus lay between the two epidermal layers which did not rupture to liberate the spores but remained covering it. It was made up of a compact dark brown pseudoparenchymatous mass of spores closely adhering to one another and not easily separating. This mass occupied the whole space between the veins having displaced the host cells. The spores were polygonal by pressure, dark brown and smooth walled. They measured  $13.5 \times 12 \mu$  ( $12-20 \times 8-14$ ).

The fungus is an *Entyloma*. Two species, viz., *E. crastophilum* Sacc. and *E. dactylidis* (Pass.) Cif. have been recorded on this host. The latter smut was originally described as *Thecaphora dactylidis* by Passerini but Saccardo regarded it as a synonym of *E. crastophilum*. Ciferri however transferred the fungus to *E. dactylidis*. The local specimen was sent to Dr. Bisby of the Commonwealth Mycological Institute, England, for correct identification. Mr. M. B. Ellis of the same Institute who examined the material remarks that it is "better to refer the smut to *E. dactylidis*". The spores of the local specimen are slightly bigger than those described by Liro (1938). The name suggested by Mr. Ellis is adopted as there is agreement in all other characters. This smut has not been previously recorded from India.

*Tragus biflorus* (*T. racemosus*) is a common grass growing in Coimbatore. A smut has been frequently observed to infect this grass in the months of November to January. The sori are ovaricolous and appear as enlarged oval green bodies upto 4 mm. in length, in some of the spikelets of the inflorescence. One to six sori have been noticed in each ear. The sorus is provided with a tough green covering which eventually bursts, exposing the dark-brown powdery mass of spores. The wall of the sorus is made up of three or four layers of host cells on the outside. These cells contain chloroplasts and hence the colour is green. Internal to these lie several rows of hyaline hyphal cells. These appear as a whitish lining to the wall of the sorus. The spores are subglobose, olive-brown, echinulate and measure  $10 \times 9 \mu$  ( $8-14 \times 7-12$ ).

*Ustilago tragana* has been described by Zundel (1943) from Transvaal, on *Tragus*

*racemosus*. Mundkur (1944) has recorded *U. tragi* Mund. on the same host from Coimbatore. The latter is however only a later homonym. The smut under study agrees closely with the above and it is therefore identified as *U. tragana* Z.



FIG. 1. *Ustilago tragana* sori ( $\times 2$ )

The spores germinate quickly in 4 to 6 hours. The sparse formation of sori in the ear suggested that infection may be through the flower. In order to verify this, the grass was grown in pots and the ears were sprayed with a suspension of spores when the flowers opened or a suspension of spores was poured into the leaf-sheath while the inflorescence was still enclosed inside. After inoculation the pots were covered with bell-jars for a period of 72

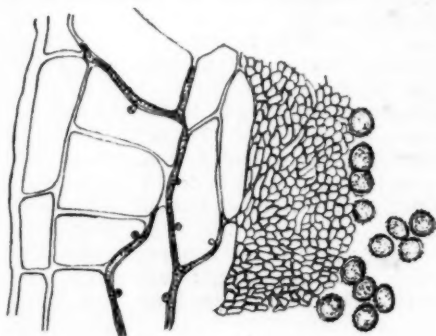


FIG. 2. *U. tragana*—Section of the wall of the sorus and spores ( $\times 200$ )

hours and later removed. On the twelfth and thirteenth days after inoculation sori appeared in the ears which were inoculated while still

enclosed in the sheath. Those that were inoculated after emergence and the controls were healthy. The experiments were repeated twice and the results confirmed. Hence in this smut the infection is through the young flower.

We are grateful to Dr. G. R. Bisby and Mr. M. B. Ellis for their kind help.

Agri. Res. Institute, T. S. RAMAKRISHNAN.  
Lawley Road P.O., K. V. SRINIVASAN.  
April 17, 1950.

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#### A REMARKABLE EXAMPLE OF MATERNAL SOLICITUDE IN A THRIPS FROM INDIA

MATERNAL solicitude in Thysanoptera has not so far been recorded. We recently came across a remarkable example of Brutpflege in a large common species of thrips, *Gigantothrips elegans* Zimmermann (Idolothripidae) at Agra.



FIG. 1. Female of *Gigantothrips elegans* Zimmermann, guarding her cluster of eggs. (Photo M. S. Mani)

The thrips breeds here in enormous numbers on the leaves of *Ficus glomerata* Roxb. during hot weather. The female lays a cluster of about two

dozen, oval, pale-brown eggs on the under side of the tender leaves. She then mounts guard over her eggs and 'sits' over them with the legs sprawling wide. She waves her long abdomen in a menacing attitude at frequent intervals as if to frighten any intending enemy. We saw her several times actually drive off small predatory mites that often stumble among the eggs. She remains in this attitude until all the nymphs have hatched. During the whole time of five to six days she never strays far away from the place of oviposition even for feeding. The beautifully striped young nymphs, which hatch first, also continue to remain under the protecting care of the mother. While thus brooding, if she is disturbed, she waves her abdomen with increased vigour, moves off to a distance but soon returns to her eggs, which she now proceeds to feel with her antennae as if to assure herself of their safety and then finally takes up her position once more on them. The leaves of several *Ficus glomerata* trees in the garden of the Zoology Department are covered by large numbers of broody females of this thrips. We include here a photograph of one of the brooding females.

Entomology School of Research, M. S. MANI.  
Zoology Department, S. N. RAO.  
St. John's College, Agra,  
May 8, 1950.

#### INDUCED LYSIS IN THE GERMINATION OF THE UREDOSPORES OF THE WHEAT RUSTS

THE tendency of the promycelia of the chlamydospores from certain crosses to lyse has been demonstrated in case of *Ustilago zeae* and *Sphacelotheca sorghi* by Chilton<sup>1</sup> and Laskaris<sup>2</sup> respectively. In both the cases the tendency to lyse was governed by genetic factor (or factors) and was characteristic of certain crosses in which the lethal factor (or factors) accounting were present in one of the parental lines and absent in the other.

While testing a home made hydrophobic colloidal sulphur spray for the control of wheat rusts, it was observed that germination of the uredospores of the black and brown rusts was inhibited on one per cent. water agar containing 20 parts per million of the fungicide. On water agar containing 10 p.p.m. of the fungicide, however, the spores of black and brown rusts produced germ tubes 10 to 15  $\mu$  long after 18 hours at 18° C. These germ tubes did not grow further, but got lysed, the protoplasmic contents extruding through the dissolved germ

tubes. In some spores, lysis occurred at the formation of the first rudiments of the germ tubes (Figs. 1 and 2), and even on water agar

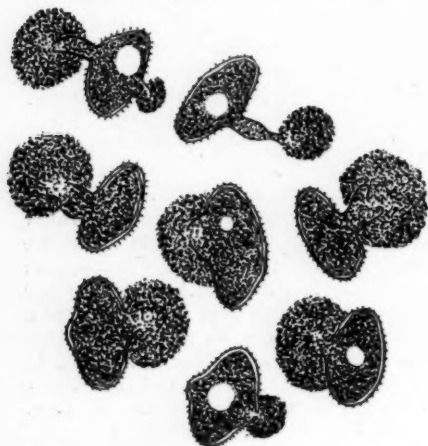


FIG. 1. Lysis of the germ tubes of the uredospores of *Puccinia graminis tritici*.  $\times 430$ .

containing 2 p.p.m., of the fungicide although the average lengths attained by the germ tubes at this concentration were  $35\mu$  and  $75\mu$  for the spores of black and brown rusts respectively.

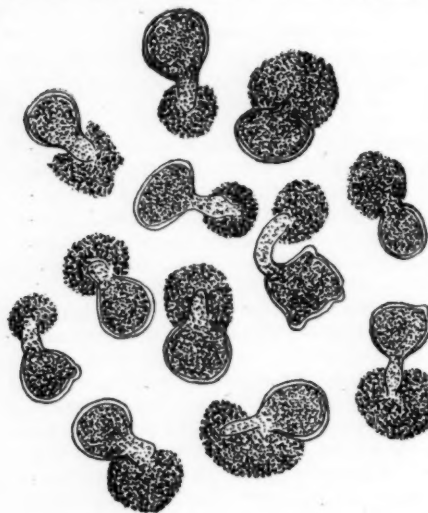


FIG. 2. Lysis of the germ tubes of the uredospores of *Puccinia tritici*.  $\times 430$ .

On water agar containing 1 p.p.m. of the fungicide, the germ tubes of the spores did not show any appreciable lysis but were smaller than

those in the control plates. In the case of yellow rust, the germination of the spores was inhibited on agar containing 2 p.p.m. of the fungicide, and lysis occurred on the medium containing 1 p.p.m. of the fungicide. The control plates showed normal germination in all the cases and, therefore, lysis of the germ tubes occurs because of the activity of the colloidal sulphur. A new term "Germinolytic" is proposed for such action of a fungicide which produces lysis of the germ tube.

The stock solution for home-made hydrophobic colloidal sulphur was prepared as follows:

One pound of powdered quicklime was slaked with half a gallon of water. To the slaking lime, two pounds of sulphur and half a gallon of water were added and the mixture boiled for about half an hour till the specific gravity of the mixture reached 1.28. Six hundred and fifty grams of molasses were then added and the whole stirred while still hot till the molasses dissolved. The solution was then decanted and stocked.

The author is grateful to Dr. R. S. Vasudeva, Head of the Division of Mycology, Indian Agricultural Research Institute, for suggestions.

Division of Mycology & M. L. GATTANI,  
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Indian Agri. Res. Institute,  
New Delhi,  
April 15, 1950.

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#### CONTROL OF LOOSE SMUT OF BARLEY

TOTAL area under barley in the Indian Union in 1946 has been reported to be 6,247,000 acres and the production to be 1,958,000 tons. Incidence of loose-smut of barley [*Ustilago nuda* (Jens.) Rostr.] varies from field to field and may be 10 per cent. or higher in severely infected fields, but at a conservative overall estimate the incidence of the disease may be put at 1 per cent. resulting in a loss of 19,580 tons. Taking the price of barley at Rs. 7 per maund the total loss would amount to over 38 lakhs of rupees.

For the control of loose-smut of barley solar heat treatment recommended by Luthra<sup>3</sup> for loose-smut of wheat *Ustilago tritici* (Pers.) (Rostr.) has been successfully employed. Infected barley seed was obtained through the

courtesy of Dr. S. M. Sikka in 1949. The seed was soaked in cold water on 23rd June 1949 from 6 a.m. to 10 a.m. and later exposed to the sun on a brick-floor from 10 a.m. to 5 p.m. The temperature of the floor during this period varied from 114.8° F.-129.2° F. but for a short period touched 132.8° F. The air temperature 4 inches above the ground level during this period varied from 105° F. to 111.2° F. The seed so treated was stored till 17th November 1949 when it was sown in two plots in the experimental area of this Division. The untreated seed was simultaneously sown in the adjoining plots. The percentage disease incidence in both the treated plots was nil as against 6.0 and 6.8 in the two untreated control plots.

It is observed that the disease can be fully controlled by solar treatment. The germination of the exposed seeds is, however, slightly reduced. It should be possible to make up the reduced germination by raising the seed-rate. Further experiments are, however, in progress to adjust the treatment in such a way that the germination is not impaired.

Div. of Mycology &  
Plant Pathology.

R. S. VASUDEVA.

Ind. Agric. Res. Inst., M. R. SESHADRI IYENGAR,  
New Delhi,  
April 24, 1950.

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# THE INHIBITORY ACTION OF GLUCOSE ON THE MECHANICAL RESPONSE OF UNSTRIATED MUSCLE

SINGH AND SINGH (1949) have shown that sometimes glucose, instead of increasing, inhibits the mechanical response of unstriated muscle produced by stimulating it with alternating current. A method has been found by which the inhibitory action of glucose can be

invariably obtained. Transverse pieces of frog's stomach muscle are stimulated every minute with alternating current, 12 volts for 10 seconds at 20-25° C. The muscle is then poisoned with sodium cyanide (1 in 100,000). 0.1 p.c. glucose is now added, when a temporary inhibitory effect is produced (Fig. 1). As the inhibitory effect is disappearing or has disappeared, removal of glucose produces a diminution of the response, showing that the effect has now become stimulatory.

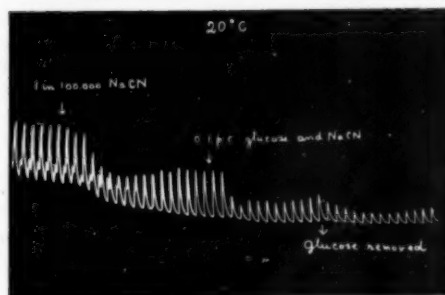


FIG. 1. Frog's stomach muscle. Stimulated with alternating current 12 volts/10 sec. per min. Effect of sodium cyanide (1 in 100,000) and 0.1 p.c. glucose at 20° C.

These results show that when the muscle is poisoned with 1 in 100,000 sodium cyanide, the energy for contraction is derived from a non-glycolytic source, as the action of glucose is inhibitory. Presence of glucose changes the metabolism, as shown by the recovery from inhibition; glucose is now utilised. This is shown by the fact that these effects of glucose are absent if the muscle is poisoned with the iodoacetic acid.

Physiological Laboratory,  
Medical College,  
Agra,  
May 5, 1950.

SUNITA INDERJIT SINGH.  
INDERJIT SINGH.

1. Singh, S. L., and Singh, I., *Proc. Ind. Acad. Sci.*, 1949, 30, 215.

## NEW OBSERVATORY AT MADRAS

KODAIKANAL Observatory is to have a city station at Madras. A 20-inch Grubb reflector has been donated by H. H. Maharaja Kumarsinhji of Bhavnagar. Construction of a dome has been approved by the Government. At the same time tests on seeing both day and night are under way to determine the suitability of

Kodaikanal itself for the installation of coronagraph equipment and a larger telescope.

Since the 20-inch will be among the largest telescopes in India, it seems a pity that it should be located in a large city.

—By courtesy of *Sky and Telescope*, June 1950



## REVIEWS

**The Presentation of Technical Information.**  
By Reginald O. Kapp. (Constable & Co. Ltd.,  
10, Orange Street, London, W. C. 2), 1948.  
Pp. xi + 147. Price 6 sh. net.

The recent Editorial appearing in the fifteenth volume of the Penguin Science News, deplores "the inability of most British Scientists to write even a proper scientific paper, let alone a popular article". It adds that this "is now causing such general concern that a number of big firms and scientific societies are appointing advisers in English literature to help their inarticulate colleagues to express themselves intelligibly and with precision."

Many a good piece of scientific work or a technical advance, is lost to the world or remains obscure for want of clear presentation.

The volume under review, when judged in the light of the above remarks, constitutes an opportune and valuable contribution to the important and indispensable art of "conveying technical information from mind to mind". The book is based on a course of four lectures delivered by the author at the University College, London.

The subject-matter is presented in the course of fifteen lucidly presented chapters. The author emphasises the importance of avoiding "the language of meaningless, stereotyped phrases, involved syntax, cumbrous sentences in which much of our technical literature is cast."

The author enters an impassioned plea for the study and cultivation of what he calls Functional English—a style which enables us to express our ideas with clarity and precision and without ambiguity, thereby saving the readers unnecessary effort.

Apart from the controversial aspects of the place of English in the scientific and technological life of this country, it is generally admitted that English will remain as the medium of science and of international intercourse. It is, therefore, necessary that we, in this country, should cultivate an acceptable style for expressing our ideas and for achieving this end, the volume under reference constitutes an admirable introduction. We have no doubt that every scientific worker and technologist will eagerly read and assimilate the contents of this volume.

**Radio Engineering, Vol. II.** By E. K. Sandeman. (Published by Messrs. Chapman & Hall Ltd., London, W. C. 2), 1949. Pp. xxii + 579. Price 40 sh. net.

This volume is a continuation of Vol. I, and contains Chapters XVII to XXV and Appendix CI to CIX, a Bibliography and an Index. Chapter XVII is a very readable and simple description of balanced and unbalanced circuits highly useful to a beginner. Chapter XVIII is a long chapter on interference and noise, providing a wide variety of useful information. Chapter XIX is on radio receivers. This topic merits more attention in a book of this kind. The attention paid to different problems is rather meagre. Thus even the super regeneration receiver is disposed of in a page. The author has paid some attention to testing and this is the commendable part of this chapter. Chapter XX is on measuring equipment, Chapter XXI on equaliser design, and Chapter XXII on level range compression, etc. These chapters contain just the information that a book of this kind is supposed to incorporate. Chapter XXIII on feed back is of a very useful character for a beginner. This is followed by a long chapter on network theory and another, on filters.

Appendix CI to Appendix CIX cover nearly a hundred pages of the book, but many of them are quite useful and well done. The author will do well to cut out the more elementary mathematical parts in a subsequent edition.

The author has taken great pains to provide a long bibliography which he admits cannot be complete. An academic and research-minded individual would regard the choice of material as arbitrary and unsystematic. But the material provides a very useful indication of how a practical engineer engaged in the profession picks and chooses from the journals available to him.

The book contains a considerable amount of valuable information on the practical side, and as such is most useful and can be strongly recommended. It may be useful to apprentice engineers who get to the "job" without systematic education. But, it is not everywhere elementary enough to go into the hands of a beginner nor advanced enough to go into the hands of Honours degree students.

S. V. CHANDRASHEKHAR AIYA,



**Non-Linear Vibrations in Mathematical and Electrical Systems.** By J. J. Stoker. (Pure and Applied Mathematics Series, Vol. II.) (Interscience Publishers Inc., New York), 1950. Pp. 273. Price \$ 5.00.

The theory of non-linear vibrations has a much wider application than is generally recognised, for most natural systems have, in fact, a restoring force which is not strictly proportional to the displacement and they can only be treated as linear systems as an approximation. The approximation is good enough for many purposes, but there are cases where it is inadequate, since entirely new types of phenomena can occur in non-linear systems, which are unknown in the linear case. The occurrence of self-excited oscillations, for example in wireless circuits, the occurrence of forced oscillations when the external force is non-oscillatory, as in the flutter of airplanes or in the bowing of a violin string, and the occurrence of subharmonic forced oscillations and combination tones are typical examples in which non-linearity plays an important part.

The book under review contains an admirable account of the fundamental mathematical principles and methods which are employed for investigating non-linear systems. In this, the author has kept in view not only the needs of the applied mathematician, but also those of physicists and engineers. Although the standard of mathematics is quite high, the book can be read by anyone having a knowledge of ordinary differential equations. Recondite mathematical details, such as existence theorems, proofs of convergence, etc., are included in appendices, so that the main book is eminently readable. Starting with an introductory chapter on linear vibrations, the rest of the book deals with the free and forced oscillations of both damped and undamped non-linear systems. The last chapter is devoted to a discussion of Hill's and Mathieu's differential equations, which occur in connection with the stability of non-linear vibrations. The book will serve as an excellent introduction to the more advanced papers in the field.

G. N. RAMACHANDRAN.

**Electronics in Engineering.** By W. Ryland Hill. (McGraw Hill Book Company, Inc., New York), 1949. Pp. 374. Price \$ 3.50.

"What? Another book on Electronics"? asks the author in the beginning of the preface, and while replying, feels convinced that

the book fulfils a definite need—that of students of engineering sciences, other than electrical, who wish to know "something of Electronics and its applications" to their problems. The power of electronics in providing precise and versatile tools for observations and experiments in diverse fields—from aeronautical engineering to physiological phenomena—has transcended the dreams of even its most ardent enthusiast of over a decade ago. To-day, there is hardly any human activity where electronic has no role to play. This explains, perhaps, the author's attempt in explaining the necessity of adding one more to an overwhelming number of books published in recent years on the subject.

Admittedly then, the book is an elementary exposition of the fundamentals and electronic circuits. The first twelve of sixteen chapters cover various types of electron tubes, photo-sensitive devices, contact rectifiers, single and polyphase rectifier circuits, amplifier, oscillator circuits as also feedback and electronic control circuits. A chapter each is devoted to amplitude modulation and demodulation, cathode-ray oscilloscope and vacuum tube voltmeter. The outstanding chapter in the book is the one which deals with transducers of various types, of which the resistance strain gauge, differential transformer and the accelerometer are discussed at some length. This should be particularly useful to students of aeronautical engineering. An appendix deals with principle of the R-C discharge circuit. Problems are appended at the end of a few chapters.

The style of presentation is lucid, and the treatment sufficiently analytical for the class of students it caters for. A few problems are worked out in the book to illustrate the discussion employing typical circuit values encountered in actual practice. The book will indeed prove useful to those who wish to have a working knowledge of the subject.

The reviewer finds "Electronics in Engineering" as more apt a title for use, instead of such confusing names as "Electronic Engineering" and "Engineering Electronics", for a course covering very much the same ground at practically the same level.

N. B. BHATT.

**Rolling of Metals.** By L. R. Underwood. (Chapman & Hall Ltd., London), 1950. Pp. xv + 344. Price 42/-.

The present volume represents a pioneer attempt to correlate widely dispersed published work on the rolling of metals on a scientific

level based on exact mathematical calculations and physical phenomena of what is now termed Mechanical Metallurgy.

The subject-matter has been methodically arranged and relates to the rolling of flat products. How vast is the field of rolling may be realized from the fact that the technique of rolling of circular shapes, of bars, angles and sections has not been referred to beside the technique of extrusion and other fabricating mechanical processes which fall within the field of Mechanical Metallurgy.

Dr. Underwood has to be heartily thanked by all students of Metallurgy for bridging a very wide gulf between what was regarded as merely rolling the material somehow and what the modern perfected rolling industry is to-day.

B. R. NIJHAWAN.

**Modern Arms and Free Men.** By Dr. Vannevar Bush (Heinemann). (Asia Publishing House, 17, Gun Bow St., Bombay), 1950. Pp. 299. Price 10 sh. 6 d.

This is a book, as its title implies, on the inter-relations of science, war and democracy; and it is written by one whose authority to deal with the first part of his subject is indisputable. For, Dr. Vannevar Bush, as Scientist-Chairman of the National Defence Research Committee in the U.S., was given war-time powers and funds unattainable by men of science in the past. The tremendous applications of science to war have completely altered warfare, and the process of change is rapid and continuous. Several chapters are given to a survey of the developments in the technique of war, with balanced forthright opinions on the limitations and possibilities of one scientific weapon after another. The treatment is comprehensive: war on land, in the air, on the surface of the sea and under the sea are all treated with the same sure command of the facts—or so it seems to the layman. A chapter on the atomic bomb was inevitable, and another on the implications of total war. Dr. Bush is out neither to allay our fears nor to frighten us. He wants us to know just what our position is, to be sensible about it, and to share his faith in democracy. For, democracy, a society of free men, is the main theme of the latter part of the book. Dr. Bush surveys skilfully the growth of the democratic concept and its imperfect practice in the U.S. He stresses the need for education at every stage, an education that keeps minds free, that trains all and yet trains the best minds, and that is strongly based on the fundamental sciences and

on the humanities. Such an education is the bulwark of democracy.

Dr. Bush has faith in his country and in her policies; on the other hand, he appears to have no patience with the view that anything really good can come out of regimented Russia. American thinking limits the sociological aspects of this work, while American enterprise and keen inventive genius animate the argument in matters of war and science. Everywhere there is evidence of a free-ranging mind, barring certain prejudices. A chapter to be recommended, for the stimulus it gives to one's own thinking, is Chapter XIII, where, to reinforce his argument that man must now choose between two opposing philosophies, he reviews in 'capsule fashion' life's progress and man's. It marks Dr. Bush as a man of vision and a great educator. His book will answer a need and may help to restore our faith in the democratic process which, despite its limitations, is the only road whereby mankind can hope to reach an adult civilised state of society. Of the strength of his own convictions, Dr. Vannevar Bush leaves you in no doubt. Whether he will strengthen yours is a matter he leaves entirely to your individual judgment.

**Science News, Vols. 14 and 15.** Edited by J. L. Crammer. (Penguin Books, Harmondsworth, Middlesex), 1949 and 1950. Pp. 158 & 194. Price 1 sh. 6 d. each.

Penguin Books have made history in the publication and popularisation of classics, modern literature and art which are brought within the reach of the common man. The series on Science News is an extension of the same commendable objective to the field of modern science which is making rapid and spectacular advances.

Exposition of scientific topics for the general reader is not an easy task and in recent years there has been a slow and steady demand for a class of science writers who can achieve this distinction. The Editor of the Penguin Science News has been able to discover and mobilise this exceptional talent and present to his readers a bunch of interesting and informative contributions.

The fourteenth volume contains among others, articles on television, the origin of the solar system, synthetic fibres and a symposium on bacteriophage. The fifteenth volume includes articles on rockets, measuring the universe, the blood of fleas, compound E, human colour vision and blood groups.

Each of the articles has been written by men who are entitled to speak with authority on their subjects. The volumes are well printed for comfortable reading and priced within the reach of every one aspiring to keep in touch with the latest advances in modern scientific thought.

**Annual Review of Biochemistry, Vol. XVIII.**

Edited By J. M. Luck and others. (Annual Reviews Inc., Stanford, California, U.S.A.), 1949. Pp. ix + 739. Price \$ 6.00.

The eighteenth volume of this pioneering series of Annual Reviews of Biochemistry follows the general pattern which distinguishes the earlier volumes and contains 23 chapters. Topics covering enzymes, carbohydrates, lipids, amino acids and proteins, nucleoproteins and nucleic acids, and vitamins are discussed both from the point of view of their chemistry and of their metabolism. The last three chapters relate to the chemistry and metabolism of plants. The rapidly expanding field of antibiotics has been reviewed by Wintersteiner and Dutcher. Wigglesworth has reviewed the subject of insect biochemistry—a topic which had not received attention since 1940. The stimulating and suggestive field of metabolic inhibitors has been ably reviewed by Winzler.

More than half of the reviews is contributed by American workers while only a third of them is reviewed by the British scientists. This is indicative of the intensive scientific activity of the American Laboratories. One would like to see contributions from the other European and Asian Laboratories in due course.

**Advances in Carbohydrate Chemistry, Vol. IV.**

Edited by W. W. Pigman and M. L. Wolfrom. (Academic Press Inc., New York, N. Y.), 1949. Pp. ix + 378. Price \$ 7.80.

This volume comprising ten contributions, is of particular interest in view of the varied aspects of carbohydrate chemistry, presented by the reviewers. The article on the Structure and Configuration of Sucrose is an attempt at marshalling strong and concordant evidence of the structure of sucrose in a convincing manner although a direct proof based on an unambiguous chemical synthesis is still lacking. Of interest to biochemists and immunologists is the article on Blood group polysaccharides, which concerns itself primarily with extractable haptens known as "blood group specific substances". Organic chemists interested in natural drugs will find Hudson's discussion on

Apiose and the Glycosides of the Parsley plant instructive and stimulating.

Biochemists will find Neuberg's comprehensive and thoughtfully planned contribution on the Biochemical Reductions at the expense of sugars, deeply interesting and inspiring. Organic chemists can discover in this article useful technique for the specific and selective reduction of certain groups which cannot be accomplished by other modes of reduction.

The difficult and wide field of plant gums and mucilages has been reviewed by Jones and Smith who have given a classification of the two natural products based on their chemical characteristics. Our present knowledge of the composition of some of the better known gums and mucilages have been given in this review.

Hexitols, which have not been so far reviewed and which have attained industrial importance, have been discussed by Lohmar and Goepf Jr. Closely related to this is the review of Boeseken on the use of boric acid for the determination of the configuration of carbohydrates.

The volume contains two reviews of applied significance: (1) wood saccharification by Harris and (2) utilisation of sucrose by Wiggins, both of great interest to fermentation technologists who employ sugar as the fundamental raw material for the production of a variety of chemicals, including organic solvents and acids.

The series of volumes on the Advances of Carbohydrate Chemistry forms a valuable and a welcome contribution to the advancement of our knowledge in this field in its pure and applied aspects.

**Technique of Organic Chemistry. Vol. I. 2nd**

edn. *Physical Methods of Organic Chemistry*. Parts I and II. Edited by A. Weissberger, (Interscience Publishers, New York), 1949. Pp. 2096. Price \$ 25.

The first edition, which appeared in 1945, comprised 736 pages, and the book has, therefore, been trebled in size in the new edition; a serious omission in the first edition was a subject index, and this has now been rectified. Thirty-two authors have contributed the following thirty-one chapters: (I) Temperature Measurement. (II) Temperature Control. (III) Determination of Melting and Freezing Temperatures. (IV) Determination of Boiling and Condensation Temperatures. (V) Determination of Vapor Pressure. (VI) Determination of Density. (VII) Determination of Solubility. (VIII) Determination of Viscosity. (IX) Determination of Surface and Interfacial

Tension. (X) Determination of Properties of Monolayers and Duplex Films. (IX) Determination of Osmotic Pressure. (XII) Determination of Diffusivity. (XIII) Determinations with the Ultracentrifuge. (XIV) Calorimetry. (XV) Microscopy. (XVI) Determination of Crystal Form. (XVII) Crystallochemical Analysis. (XVIII) X-Ray Diffraction. (XIX) Electron Diffraction. (XX) Refractometry. (XXI) Spectroscopy and Spectrophotometry. (XXII) Colorimetry, Photometric Analysis, Fluorimetry and Turbidimetry. (XXIII) Polarimetry. (XXIV) Determination of Dipole Moments. (XXV) Conductometry. (XXVI) Electrophoresis. (XXVII) Potentiometry. (XXVIII) Polarography. (XXIX) Determination of Magnetic Susceptibility. (XXX) Determination of Radioactivity. (XXXI) Mass Spectrometry.

Physical methods have become increasingly important to the organic chemist. The objects of the book under review and of the volumes which are to follow are to provide the organic chemist with a full account of tested methods, as well as the theoretical background for understanding them and for interpreting the results. These objects have been fulfilled in the first volume of the series with conspicuous success. The theoretical treatment is excellent, and description of apparatus and technique is thorough; the names of manufacturers (mostly American) have been mentioned for many instruments, and for some even the price. However, organic chemists, especially workers in branches of applied organic chemistry such as the technology of textile fibres, would have welcomed the inclusion of more information on the application of physical methods to problems in organic chemistry and technology. Thus, the very valuable and authoritative chapter of W. D. Harkins on surface and interfacial tension does not refer to wetting and detergency. Thermostats for low temperatures in the chapter on temperature control, the density of fine powders in the chapter on density, salting out of dyes, measurements of the solubility of gums, resins and other high polymers, the crystallinity and fine structure characteristics of macromolecular substances, and commonly available pH meters, are some of the topics justifying inclusion or further treatment. The writing of individual chapters by specialists in the field has obvious advantages; but this has also the disadvantages of some overlapping, disproportionate treatment of various topics, and lack of co-ordination. The chapters on the ultracentrifuge (110 pp.),

refractometry (100 pp.), spectroscopy and spectrophotometry (158 pp.) and polarography (100 pp.) are among the chapters which constitute comprehensive monographs, while the chapter on viscosity (27 pp.) has been written from the point of view of the special interests of the senior author (Mark). The chapter on polarography is especially useful because earlier reviews have been mainly concerned with its inorganic applications.

The printer and publisher have done their work exceedingly well. Reference 45 instead of 46 on p. 321 and cyclohexene instead of cyclohexane on p. 828 are the only two errors noticed during a rapid perusal. Although the price is high, it is not unreasonable, considering the size and importance of the book, and every research worker in organic chemistry will find that he must have a copy of his own, if he can possibly afford it.

K. V.

**Bananas—Chemistry, Physiology and Technology.** By Harry W. Von Loesecke. (Interscience Publishers, Inc., 215, Fourth Avenue, New York 3, N. Y. or Interscience Publishers, Ltd., 2 a, Southampton Row, London, W.C. 1), 1949. Pp. xi + 189. Price \$ 4.50.

The book is to be commended to the reading public and more particularly to those interested in fruit plants. The chemical changes during ripening have been exhaustively dealt with. The vitamin potency of the banana is fully described and the table on page 145 gives a comparative statement of vitamins present in the various important fruits and vegetables. The usefulness of this table would have been greater if other tropical fruits like the mango, the pineapple, etc., had been included in this table.

The author cites many references in regard to its origin. It is said in the last para on page 5 that the banana has probably originated in the Indo-Malay region. But in the second para on page 6 it is said that the banana was found growing in the Indus Valley in the year 327 B.C. The latter year being the earliest on record about the growing of banana, India should, therefore, be considered as the original home of the banana, and this view is supported by other evidence also.

The terms green banana and unripe banana are used for one and the same thing (page 130, lines 1 and 3). Even though the colour of the unripe fruit in most varieties of banana is green, the colour of the unripe fruit in some



varieties is purple or greyish white. The term 'unripe', therefore, seems the more appropriate for use than green.

On page 131, para one, methods of drying bananas are described. A layman may not be able to make out whether the ripe or the unripe bananas are meant. I may mention here that what is described in the first para is a method of drying ripe bananas while what is described in the second para is a method of drying unripe fruits.

There are a few printing mistakes : come for some (page 43, para 4). *Cocoonut* for *coconut* (page 11, para 2, line 3). *Panchamruihan* for *Panchamrutham* ; *Palmi* for *Palni* (page 135, para 2, lines 2 and 6).

K. C. JACOB.


**Advanced Chemical Calculations.** By S. J. Smith. (Macmillan & Co., Ltd., London), 1950. Pp. viii+454., 17/- net.


The book under review is a sequel to the author's 'Introductory Chemical Calculations' but of a far advanced character so as to fulfil the requirements of students taking the degree courses in chemistry, Pass as well as Honours. Ability to solve numerical problems is the most convincing test at our disposal to ascertain whether a student has fully understood the theory of the subject. There are very few books of this type in the field and this book in particular should be welcome to the teacher as well as the taught. I have often found that a majority of students avoid numerical problems or develop a dread for them and to such, this book should be of immense help. The book covers the different branches of the subject, namely, General, Analytical, Organic and Physical Chemistry and provides a comprehensive, unbiased and complete course in numerical chemistry. The opening chapter is intended to be a link between the older elementary book and the present advanced one. The succeeding chapters are all of an advanced character, each chapter giving a clear and succinct account of the theory followed by mathematical derivations relating to the portion covered in each. Choice worked-out examples provide sufficient guidance in the solution of problems contained in each chapter. Interspersed between the various chapters is a representative list of 'Miscellaneous Questions' taken mostly from the examination papers of various Universities. In a work of this kind there is always the possibility of stray errors creeping in and from a few examples chosen at random, I have

come across only one whose wording can be improved and which has a slip in the solution (Problem 79 *vide* Miscellaneous Questions, Chapters XIII-XV, page 294). From the data given, the compound (D) should be nitrogenous and further reactions of the compound mentioned establish it to be a primary amine

of the formula  $\begin{array}{c} \text{CH}_3 \\ \diagdown \\ \text{CH}_2 \\ \diagup \\ \text{CH} \end{array} \text{NH}_2$  giving a secondary

alcohol and thence a ketone, whereas the formula given on p. 449, is  $\text{CH}_3 \cdot \text{C}_6\text{H}_4 \cdot \text{COOH}$ , which is evidently the formula for (E). The latter part of the problem is better worded as 'The compound (E) on oxidation gives an aromatic dibasic acid readily yielding the anhydride of the formula  $\text{C}_8\text{H}_4\text{O}_3$ .' This would enable the student to fix the formula of (E) and the nature of (F) as phthalic anhydride.

The compound (F) is  $\text{C}_8\text{H}_4$   and not

$\text{C}_8\text{H}_4$   as stated on p. 449 which gives

$\text{C}_9\text{H}_4\text{O}_3$  as the formula. The author should be congratulated on the production of a good book on numerical problems much needed at present, containing a wide choice of graded problems and every student of chemistry should possess this excellent book and make good use of it to stabilise his knowledge. M. V. S.

**Flood Estimation and Control.** By B. D. Richards. Second Edition. (Messrs. Chapman & Hall), 1950. Pp. xiii+173. Price 21 sh. net.

Since the success and safety of schemes involving the construction of dams and barrages depend largely on a correct estimation and control of floods, this subject is necessarily of great importance to an engineer. The engineers have to be grateful to the author for bringing within the compass of a book all the literature scattered in various publications. His approach to the subject is very original and thought-provoking.

In the development of the equation  $t^3 = \frac{CL^2}{Kis}$  in Chapter V, the author assumes that in the flow from a catchment the depth 'd' will be very small compared to the width and 'r' will be equal to 'd'. He also assumes there is only one slope along which run off flows. All catchments will necessarily have two slopes, one from the water shed line to the gully formed in the valley between two hills, and another along the gully from its origin to the point of concentration. Thus, run off will have two



different velocities, initially along the side slope and later along the longitudinal axis of the gully. The ratio of depth to width in a gully is too appreciable to be ignored.

The Inglis formula as given on page 11 may be corrected to  $Q = \frac{7000 A}{\sqrt{A+4}}$ . It would be very in-

teresting if an example of calculating the peak flood according to his theory can be worked out for a catchment covering several thousand square miles.

The usefulness of the book will be enhanced if a chapter on estimating total run off can be added. Sri. A. N. Khosla's formula in this connection may be included.

N. S. GOVINDA RAO.

**Indian Hill Birds.** By Sâlim Ali. Illustrated by G. M. Henry (Oxford University Press), 1949. Pp. lii + 188, Price Rs. 20.

Bird watching is a fascinating, inexpensive and health-promoting past-time which lies within the reach of every scientific minded and enlightened individual. It entails bracing excursions to the countryside, visits to groves, forests and hills. The study of birds among whom are to be found some of the most beautiful of Nature's creations, involves a scientific elucidation of their habitat, their life-history, their song and their migratory instincts.

The volume under review is an excellent introduction to the subject of the study of birds in general and to the Indian Hill Birds in particular. It is written by one of the world's foremost authorities in ornithology. In the author's own words the book, "while conforming with all requirements of an up-to-date scientific work, is intended primarily for the non-technical bird lover".

About 300 species of birds are covered by the volume and these include those most likely to catch the eye or the ear of the hot-weather visitor to the Hill stations of India—Himalayan as well as Peninsular. More than thirty per cent. of the birds described, are beautifully illustrated in colour, specially painted for this work by Mr. G. M. Henry, the well-known bird artist. The Oxford University Press, the publishers, have to be congratulated on the beautiful get-up of the book and the artistic reproductions of the coloured plates.

We are confident that this authoritative volume will serve to inspire many more men and women to "swell the ranks of competent

bird watchers" and enrich the knowledge of birds in all its varied aspects.

**Plant Pathology.** By Sir Edwin J. Butler and S. G. Jones. (Macmillan & Co., London), 1949. Pp. 979. Price £ 3-3-0.

The present work is practically a new book, for it would not be correct to say that it is just a revision of Dr. Butler's earlier work (1918) with the substitution of some new diseases. The book would definitely have gained immense value if the diseases of crops like rice, sugar-cane, sorghum, corn, cotton, citrus, coffee and others which are important in many parts of the world, had been included in place of the diseases of trees and ornamentals. Even under the crops that have been dealt with, diseases like early blight of potato, etc., have been omitted because they are not of much importance in England. On the other hand, diseases like *Epichloë typhina* (choke disease of grasses) are given undue importance.

Part one of the book deals with the general principles of plant pathology. It is exquisitely presented, containing a wealth of information and incorporating recent advances in our knowledge of the subject. In the second part, selected diseases of cereals, forage crops, root crops, pulses, vegetables, fruits, ornamentals and trees are described. The information presented is very valuable, and the illustrations are excellent and worthy of emulation.

In a book of this magnitude, it would be difficult to avoid small errors. Some obsolete names like *Asterocystis radialis* (p. 11), *Macrosporium commune* (p. 31), *Eroascus minor* etc., are still retained. Under classification, the name *Ancylistales* (p. 331) is maintained instead of *Lagenidiales*, though *Ancylistis* is now known to be a *Zygomycete*. *Cystopus* and *Albugo* are misprinted as separate genera (p. 332). *Molinia* (grass) has been confused with *Monilia* (p. 335), which is the conidial stage of *Sclerotinia*. In the classification of rusts and in the placing of genera like *Phyllachora* and others, recent trends of research have been neglected. These remarks, however, do in no way detract the value of the book which contains a wealth of information and offers useful references to research workers in the field of plant pathology. The book is heavily priced, but it is hoped that it would be within the reach of all students of plant pathology.

M. J. NARASIMHAN.

## SCIENCE NOTES AND NEWS

### Occurrence of *Psilotum nudum* (L.) Griseb. (*Psilotum triquetrum* Sw.).

Sri. B. S. M. Dutt, Botany Department, P. R. College, Kakinada, suggests that as *Psilotum triquetrum* Sw. has been found in many places in Vizag, Godavari, Ganjam (author's collection in 1947), North Travancore (collection in 1944 by Mr. T. U. Chacko), Nilgiris, Coimbatore and Tinnevely,<sup>3</sup> it may well be that its distribution in South India is not so scattered as was once supposed.<sup>2,4</sup>

He collected it a few years ago from a forest near Vathangi (about 2,000 feet above sea-level), recorded in a paper by Venkateswarlu<sup>4</sup>; and recently, in three different places near Araku Valley, viz., Jilda (3,400 ft.), Galikonda (3,600 ft.) and Anantagiri (3,800 ft.).

The plants were 7-20 inches high. In Anantagiri, they were found in the hollow of a tree, but in the other two places the rhizome was either exposed on rocks or sunk in crevices near a water course. In Vathangi as well as in Jilda and Galikonda, specimens of *Gnetum* were also seen within 100 yds. of the *Psilotum*.

His grateful thanks are due to Prof. P. Maheshwari, University of Delhi, for going through the manuscript, and to Mr. M. B. Raizada of the Forest Research Institute, Dehra Dun, for identifying the plant and for much useful information.

1. Joshi, P. C., "Occurrence of *Psilotum* Sw. in the Punjab," *Curr. Sci.*, 1935, **3**, 486. 2. Mahabale, T. S., and Deshpande, G. S., "*Psilotum triquetrum* Sw. at Lonavla, Bombay Presidency," *Ibid.*, 1942, **12**, 406. 3. Raizada, M. B., "The Genus *Psilotum* in India," *Indian Forester*, 1935, **61**, 654. 4. Venkateswarlu, V., "On the Occurrence of *Psilotum triquetrum* Sw. in the East Godavari District," *Science and Culture*, 1944, **9**, 165.

### Third Indian Pharmaceutical Congress

The Third Session of the Indian Pharmaceutical Congress will be held at Calcutta on the 30th and 31st December 1950, Dr. Sir J. C. Ghosh, Director, Indian Institute of Higher Technology, Calcutta, presiding. Reading of scientific papers and symposia on selected topics of pharmaceutical interest will form the main programme. The occasion will be utilised to establish contact on an international basis

among scientific workers interested in Pharmacy and allied sciences.

### Tuberculosis Seals Sale Campaign

The Tuberculosis Association of India has decided to start a Tuberculosis Seals Sale campaign from this year. This campaign will serve not merely as a means of raising funds but also as a medium of health propaganda. The Stamps Sale in India is designed to give every individual an opportunity to contribute his or her mite to the anti-tuberculosis campaign. The money collected by this method will be used for the extension of the activities of both the Central and State Associations in different parts of the country.

The Seal Sales Campaign is scheduled to start on 1st October 1950, and end with a Tuberculosis Week in January, 1951. The Central Association will distribute to the State Associations Stamps required by them for the campaign. The target for this year's campaign is the sale of one million sheets of 35 stamps each.

### Production of Radio-Active Isotopes

The British Ministry of Supply state that there has been an enormous increase in both the quantity and variety of radio-active materials being produced at the Atomic Energy Research Establishment at Harwell for industrial, medical and academic purposes. The total of consignments during the year was 3,443. About half the shipments consist of irradiated materials which do not have to be chemically processed. The other half are chemically separated in the laboratories. Some of the heaviest buyers of British-produced isotopes are Australia, South Africa, Sweden, Switzerland and Holland.

### Award of Research Degree

On the recommendation of the Board of Examiners consisting of Prof. Robert S. Mulliken, Prof. W. Jevens, and Prof. R. W. B. Pearse, appointed to adjudicate on the thesis entitled "Studies in the Complex Spectra of certain Atoms and Diatomic Molecules," the Syndicate of the Andhra University have resolved that Mr. V. Ramakrishna Rao, M.Sc., be declared qualified for the degree of Doctor of Science.

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